Risk and Options in Executive Pay

Rodion Skovoroda

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Faculty of Business and Law

Department of Strategy and Management

De Montfort University, Leicester

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ABSTRACT

This thesis addresses the issue of an effective and efficient executive pay system and tries to add to our understanding of equity-based incentive-performance mechanisms. Executive pay is viewed here as a corporate governance tool for easing the agency problems of a modern corporation. Empirical evidence and careful risk-related analysis of the pure financial incentives created by equity-based pay suggest a non-monotonic pay-performance relationship, due to managerial conservatism in investment appraisals. The agency problem for top executives with endogenous firm risk is modelled. "Certainty-equivalent" approach to cost analysis of executive equity is extended to encompass the risk-related agency problem. New indexes for managerial conservatism (RR ratio) and opportunity costs of executive option grants, or minimum assumed incentive effect (MAIE), are designed and tested for significance on subsequent firm performance alongside the index of risk-adjusted wealth-performance elasticity (WPE). Performance sensitivity to equity-based managerial incentives is found to be higher in R&D intense industries. Excessive managerial conservatism is found reducing the quality of incentives and may lead to under-performance. Executive option schemes are found to be a generally more effective solution of the agency problem than grants of underlying shares due to their pay convexity. This relative options efficiency may especially benefit risk-sensitive, opaque businesses. Proportion of outsiders on the board and board's nomination committee size are associated with more efficient option grants (efficiency is measured by empirical relation with firm TSR). CEO/Chairman duality and CEO control over board dynamics (e.g. through chairing board's nomination committee) are associated with significantly amplified (up to 70%) option costs and with significant acceleration in rates with which CEOs accumulate their holdings of firms' shares. Higher equity accumulation rates may in the long-run (if CEOs stay in power for 10 – 15 years) result is excessive managerial risk-bearing, not associated with ex-post efficiency of incentives.

.....To my father Andrei

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LIST OF ABBREVIATIONS USED

(With references to their definitions in the text)

CEO – Chief Executive Officer

CG – Corporate Governance

EPS – Earnings per Share

INCD – Independent Nomination Committee Dummy (section 7.2.1)

LTIPs – Long Term Incentive Plans; annual grants of restricted shares to company's employees, usually subject to 3 years performance period, popular among UK based firms; performance hurdles may include accounting measures, share price targets, personal/group targets.

MAIE – Minimum Assumed Incentive Effect of Executive Options (section 4.5)

PPS – Pay-Performance Sensitivity (section 2.7)

RR – Risk-Reward ratio (sections 2.8.4 and 4.3)

TQ – Tobin's Q

the ratio of the firm's market value to the replacement cost of its physical assets

Market-to-Book Ratio –

the ratio of the current share price to the book value per share.

It measures how much a company worth in comparison with the amount of company's capital invested by shareholders.

TSR – Total Shareholder Return = Log (P_t / P_{t-1})

where P_t is share price at the end of year t.

WPE – Managerial Wealth-Performance Elasticity (section 7.1)

WPS – Managerial Wealth-Performance Sensitivity (section 2.8.4)

WRE – Managerial Wealth Elasticity to Firm Risk (section 7.2.2.B)

WRS – Managerial Wealth Sensitivity to Firm Risk (section 2.8.4)

CHAPTER 1. OBJECTIVES OF THE RESEARCH

Objectives of the research:

1. Introduction of agent discretion over firm risk to the top management agency problem; correspondent revisions to basic moral hazard models with linear incentive schemes; discussion of developed hypotheses
2. Extension of the certainty-equivalent framework on executive equity-based wealth with the analysis of the effect of shares and options on managerial risk seeking, and with the developing of MAIE index, measuring firms' financial costs of granting shares and options to top managers
3. To test empirically for the overall efficiency (measured by empirical relation with subsequent TSR) of executive option grants adopted in top UK companies and share-based incentives in the 1998/99 financial year. A risk-related element, designed upon achievement of first two research objectives, to be incorporated in the statistical tests in an attempt to control for a reduction in the incentive effects due to managerial risk-aversion.

Growing attention has been paid to executive compensation in the business and economics literature as well as in the press. All are concerned with trying to find ways to design an effective executive compensation system, a system which provides an adequate structure and value of managerial remuneration.

The modern history of executive compensation research began in the early 1980s with the general acceptance of agency theory. Agency theory analyses the conflict of interests between a principal and an agent which arises from the separation of ownership and control in modern corporations and most research on the relation between executive compensation and company performance utilises this principal-agent framework.

Berle and Means (1932) first used the term "separation of ownership from control" to point out that corporate managers often tend to take actions that are not optimal from the shareholders' point of view. They stressed that corporate managers tend to serve their own interests and are able to take unobserved actions that reduce the return to shareholders and result in waste and inefficiency. Agency theory, first formalised by Ross (1973), Becker

and Stigler (1974) and Lazear (1979), has been greatly developed by Holmstrom (1979) and Grossman and Hart (1983). They viewed executive compensation as a tool for the principal to manipulate the agents' interests and efforts, suggesting that by tying pay to the stock market performance of the firm, managers will be provided with strong incentives to promote shareholder value.

However, in spite of the belief that stock market-based compensation will improve managerial incentives and subsequent company performance, empirical evidence is mixed and inconclusive. Abowd (1990) admits that the results supporting the claim of market-based compensation advocates have a low degree of precision. Murphy (1999) emphasises that "...there is surprisingly little direct evidence that higher pay-performance sensitivities lead to higher stock-price performance".

This thesis argues that this apparent lack of agreement between the theory and the empirical evidence is not due to flaws in the theory. Instead, it argues that one of the reasons why existing empirical studies on managerial compensation tend to provide little support even to some basic theoretical predictions is that the choice of the principal-agent models in the empirical studies is often not appropriate for the observed principal-agent situations. For example, classical moral hazard models (Holmstrom (1979)), widely utilised in applied studies on many service activities, analyse effort level incentive problem modelling level of agents' effort as agents' response to the incentives that are set up by the principals. In this type of models, the term "effort" means all employee inputs that are not directly observable by the principal-owner.

Many empirical studies on managerial incentives and managerial compensation have tested the predictions of the basic moral hazard models with mixed results (e.g. Cyert et al. (1997); Aggarwal and Samwick (1999); Conyon and Sadler (2001); Cyert et al. (2002), Core and Guay (2002)). One of the key suggestions of the basic moral hazard models with linear incentive schemes (which imitate managerial shareholdings) is that of a negative relationship between firm risk and managerial share-based pay. This suggestion is a result of a persuasive reasoning that increased firm risk elevates risk burden of risk-averse managers compensated with risky equity, disturbs risk-sharing optimum and lowers the total amount of equity which would maximize managerial incentives. However, contrary

to theoretical expectations, in practice firm risk was found decreasing or increasing the use of profit sharing schemes. Persistent inconsistency between empirical results and theory thus seem to suggest the rejection of the theory.

The key observation is however that models with linear incentive schemes which are used in applied studies to describe top management agency problem very often do not allow managerial generalized "effort" to influence firm risk (and therefore remuneration uncertainty, as one could naturally expect if managers are compensated with shares). Since the term "effort" is used to designate all managerial inputs, it follows that those agency models popular in applied studies and thus get empirically tested do not account for top managers controlling or influencing firm risk, which seems implausible. And those are exactly the models which predict a negative relationship between firm risk and managerial share-based pay. From this perspective, the failure of empirical results to fully support propositions of evidently oversimplified models is not surprising. It is argued in this thesis that applied studies on the top management agency problem should make ensure that they allow some agent discretion over firm risk in their models.

Indeed, it is widely accepted that providing incentives for managers to promote shareholder value is a sterner task than simply forcing managers to work harder (Holmstrom, 1992). The manager can choose the action from a very rich set that includes judgements concerning risks (Murphy, 1999). It is argued here that managerial action should be viewed as a generalised investment that managers undertake, since the manager defines business strategies including debt and equity financing, dividend policy, selecting preferred markets and industries to enter or exit and many other complex issues, all involving major allocations of the firm's resources. Moral hazard models in which managerial actions do not influence firm risk, in contrast, are designed to analyse effort level incentives of a hired worker who has no power to re-allocate the firm's investments, change production processes and hence the production function. As a result, if used as a theoretical background in studies on managerial remuneration and not adjusted for the potential link between managerial actions and firm risk, models based on moral hazard model CEOs and top managers as they would model an average hired worker with no ability nor incentives to alter or influence their firms' investment preferences and idiosyncratic risk.

The managerial role is quite unique in the sense that, apart from firm profitability, managerial actions may affect firm risk, for example through various forms of product diversification. The higher the manager is ranked, the greater the impact of his or her decisions on firm risk may be. Top managers undoubtedly have both the power and desire to control firm risk to some extent. Basic principal-agent models used in applied studies fail to represent this fact, usually holding volatility of the "noise" term in production functions (i.e. firm risk) constant, regardless of managerial action. They also fail to reflect fully on the fact that more profitable opportunities usually come with greater risk for the firm.

This thesis formally introduces managerial discretion over firm risk in top management agency problem through an aggregation of the generalized managerial "effort" into an action vector *(π, a)*, allowing the first element of the vector influence firm risk, and the second element be risk-independent. Managerial conservatism in investment appraisals, excessive diversification and "empire building", therefore, adversely affect risk-related element π of managerial action. Perks consumption, excessive retention of earnings and managerial shirking resulting in waste in firm's resources (e.g. due to the failure to minimise operational costs) is captured by risk-independent element *a*. Risk-independent element *a* is still referred to as "effort" in a sense that it is costly for a manager to maintain high levels of *a* and low waste of firm's returns.

Since the main function of an efficient compensation system is to align managerial (agents') interests with their shareholders' (principals') objectives, appropriately designed compensation system would ensure efficient risk sharing between managers and shareholders (which could help in optimising firm risk through appropriate risk-related managerial actions π). Although the risk sharing issue is widely discussed in agency theory (Jensen and Meckling, (1976), Jensen (1986), Salanie (1997)[1]), in their comprehensive review of existing empirical studies Pavlik, Scott and Tiessen (1993) point out that "Most compensation-performance studies have emphasized the incentive rather

[1] Concept of efficient risk-sharing developed in agency theory states that managerial risk-aversion limits efficient use of outcome-based incentives; managerial pay should not depend too strongly on firm performance and associated idiosyncratic risks (Salanie, 1997).

than the risk-sharing aspects of contracts" (p. 157). Moreover, as mentioned above, applied principal-agent studies usually refer to models which do not allow for any explicit link between managerial actions and firm risk, thus failing to reflect fully the fact that managerial action is essentially different from that of an average hired worker.

This research tries to stress out that to ensure the design and implementation of efficient equity-based compensation system one should address both effort-related and risk-related aspects of managerial compensation. It is argued further that any research, which fails to consider the investment decision process as a core element of managerial action, tends to underestimate the effect of managerial risk-aversion on company performance. Although acknowledged in theory, the risk-related element of the top management agency problem is argued to be underestimated and under-researched in applied studies, partly due to the limitations of popular moral hazard models.

The present study attempts to fill this gap through some revisions to existing theoretical models and hypotheses and through the empirical analysis of UK managerial compensation in FTSE 350 firms. The thesis shows that introduction of the link between managerial actions and firm risk to the applied agency models with linear incentive contracts has a significant effect on the hypotheses produced and increases their predictive power. It will be shown in Chapter 3 that managerial discretion over firm risk, hypothesised in this thesis, may stop and even reverse the alignment effect of *unhedged* equity-based compensation. If this type of pay is used too aggressively, managers may become too preoccupied with reducing firm risk rather than with pursuing positive-present-value projects.

The thesis shows that managerial control over firm risk may help explain curious non-monotonic relationship between managerial shareholding and firm performance, first documented by Morck et al. (1988) and later reported by McConnell & Servaes (1990), Himmelberg et al. (1999) and many other authors (see Table 2, section 2.8.1). In contrast to a power-based managerial "entrenchment hypothesis" proposed by Morck et al., managerial control of firm risk together with the presence of unhedged equity-based compensation is argued to provide an explanation to this non-monotonic relationship based on pure financial incentives on the part of the managers. As the revised moral

hazard model show, managerial control of firm risk may explain why in practice greater firm risk (as well as greater managerial risk-aversion) may indeed decrease or increase the use of profit sharing schemes.

In the UK, executive compensation usually contains four basic components: a base salary, an annual bonus tied to accounting performance, stock options and long-term incentive plans. (They also enjoy pensions and perquisites.) Most managers also hold shares in their own companies. Until recently, however, empirical researches on the subject faced serious data constraints. Scarcity of data often prevented the accurate analysis of managerial stock and option holdings. Details of executive base salaries were not disclosed in the USA until about 1950 (Lewellen, 1975), and until the late 1970s, even the USA Securities and Exchange Commission did not require full disclosure of managerial share options.

Although option grants in the USA and UK were rare in the 1970's (Lewellen, 1975; Yermak, 1993), there has been an explosion in stock option grants in the 1980's and 1990's. Nowadays, the option component is an extremely important part of managerial remuneration and should be publicly disclosed. For example, in the UK, information on individual directors' remuneration can now be found in firms' annual reports. As reported by Murphy (1999), in the US, nearly two thirds of CEOs in the S&P 500 receive options as a part of compensation package. In 1996, options composed more than 30% of median CEO pay. Moreover, Blair (1994) documents that, in 1992, stock options constituted the largest part of annual pay packages that exceeded $5 million. Overall, the explosive growth of CEO pay levels during the 1980's and 1990's can be explained primarily by increases in the value of stock option grants. As Washington Post describes it: "Executives' pay packages became increasingly skewed toward options" (Samuelson, 2002).

Due to this central role options play in contemporary compensation practices in the USA and UK, it is very important to understand relative pros and cons of this type of pay over, for instance, compensating with firm shares. Potential benefits of convex, option-like pay schemes are well acknowledged both by researchers and practitioners. However, partly due to the relative complexity of this type of pay, relevant quantitative researches are very rare and inconclusive (Guay, 1999). Thus, another objective of the research is to propose a

more refined methodology to include executive options with various exercise prices and option terms in compensation studies. The thesis analyses the financial costs of equity-based managerial pay to the firms, using the "certainty-equivalent" framework developed by Lambert, Larcker and Verrecchia (1991) and Hall and Murphy (2000). The thesis extends the certainty-equivalent framework with the analysis of the effect of shares and options on managerial risk seeking, and with the developing of an index, measuring firms' financial costs of granting shares and options to top managers. This framework develops mainly around executives' options on the shares of their firms, but this approach may clearly be applied to other forms of market-based compensation: restricted stock in the USA and Long Term Incentive Plans in the UK.

- The thesis extends a dynamic view on the incentive-performance relationship, suggested by Abowd (1990) and analyses the observed link between the managerial pay structure and subsequent firm performance. Thus new, refined indicators of managerial incentives are developed and tested with an attempt to improve specification and explanatory power of some widely used empirical tests on pay-performance relationship.

The research focuses mainly on the equity-based part of managerial package: stock and option holdings. Various effects of equity-based compensation on managerial objectives and their strategic decisions will be considered in an attempt to improve our understanding of incentive-performance mechanisms and provide general guidance to efficient minimisation of agency costs in modern corporations. Some necessary institutional preconditions for efficient design of the executive pay package will be revealed and discussed.

Bebchuk et al. (2002) summarize the limits to forces which help to design and maintain contract efficiency in practice: managerial power, limitations to market efficiency and to the power of shareholders. David et al. (1998) view executive compensation as an outcome of a power struggle between managers and shareholders. Baker et al. (1988) emphasise that compensation systems linking pay with performance may encourage executives to spend their time counterproductively on lobbying for easier performance hurdles and more generous rewards. In practice therefore, the incentives' quality and the efficiency of actual incentive contracts (e.g. executive share and option plans) in solving

agency problem are hypothesised to be higher under strong corporate governance as strong corporate governance would help to control for potentially substantial influence of managerial power on size and structure of compensation contracts.

To sum up, this thesis addresses the issue of effective and efficient managerial remuneration systems as a governance mechanism. The study addresses the effects of value and structure of this remuneration on the managerial decision-making process and relates these effects to the main objectives of residual-claiming owners. Executive pay is viewed here as a corporate governance tool for easing the agency problems of a modern corporation.

Of central importance to the study is whether or not the practice of equity-based managerial incentives adopted in the largest UK based companies is justifiable and ultimately pays-off.

CHAPTER 2. LITERATURE REVIEW

2.1 The Dominant Paradigm in Corporate Strategy Research

"It is inconceivable that purposeful action on the part of human beings can be viewed as anything other than responses to incentives... Rational individuals always choose the option that makes them better off as they see it."

Michael Jensen (1994), *Self-Interest, Altruism, Incentives, & Agency Theory.*

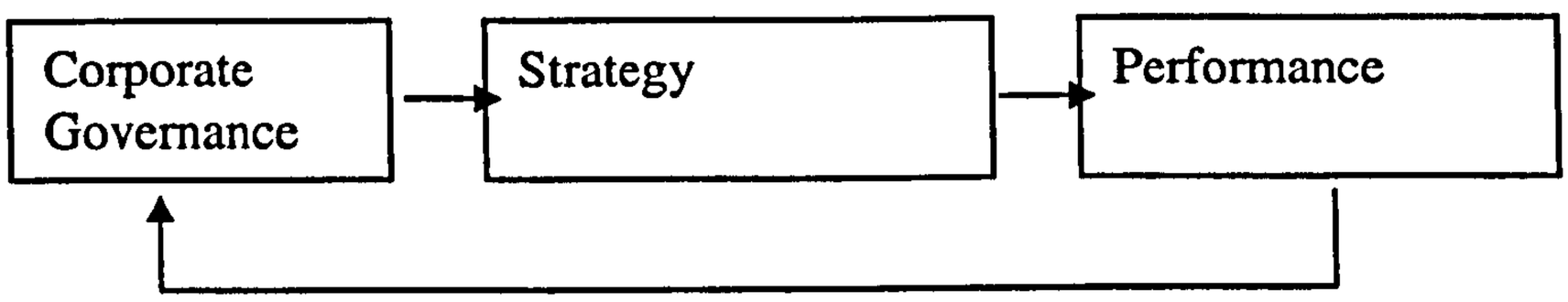
Since managers are considered as agents of a corporation's owners, the owners should have some instruments to monitor and manipulate managerial decisions and thus corporate strategy itself. This raises the question of the mechanisms by which corporations are governed and controlled. The issue is extremely wide and complex and many efforts have been spent in the literature to clarify this. This section of this literature review introduces the basic philosophy and general framework of modern corporate strategy studies.

A publicly traded modern corporation can be broadly viewed as representing a set of institutional arrangements for governing the relationships among all of the parties that contribute firm-specific assets who are thus vulnerable to managerial opportunism (Blair, 1995). Based on this, we should consider all stakeholders (not shareholders alone) as they effectively create value for a corporation. Thus, if defined broadly, *corporate governance* is concerned with a system of legal, cultural and institutional arrangements that establishes who controls the corporation, how that control is reinforced, and how the returns and risks of the corporation are allocated. Many researchers who focus on the relationship between shareholders and managers, however, define corporate governance in a more narrow sense. Shleifer and Vishny (1997) express this more narrow view on corporate governance in their survey as "the ways in which suppliers of finance to corporations assure themselves of getting a return on their investment" with shareholders' rights considered as central. Under any of the two considered definitions, of vital importance is that a corporate governance system be developed to help to allocate and use the firm's resources in a most efficient way, although the measures of efficiency may vary according to the interests of chosen claimants. It can be argued, therefore, that control rights should be given to the

party which can potentially be most effective in minimizing the waste of firm's resources (Zingales, 2000). Differences across national economies on this issue are well documented, with shareholders rights being promoted in the US and UK and more broad stakeholder approach being popular in Germany (relevant recent reviews and studies include Dore (2000), Noteboom (1999), Hall and Gingerich (2001)).

The dominant paradigm in corporate strategy research is shown by Figure 1 (Hoskisson and Turk, 1990).

Figure 1. The dominant paradigm in corporate strategy researches



Formulated in very general terms, the paradigm states that corporate governance influences the firm's strategy, which, in turn, influence firm performance. Feedback from performance to corporate governance completes the loop.

The literature has described many direct and indirect mechanisms by which corporate governance may influence the firm's strategic decisions. Here a number of them are mentioned: *the board of directors and its committees, the internal system of monitoring and control, the market for corporate control, the market for managerial labour, and the executive compensation system.*

- The *board of directors* is viewed as a crucial element in the governance structure of the large corporation (Fama & Jensen, 1983a, Baysinger and Hoskisson, 1990) with board size and composition attracting enormous attention. It is widely acknowledged that the board of directors should try to resolve any conflict of interests since they have the formal power to govern. The academic literature has largely examined the efficacy of alternative structures for the board with questions mainly about whose interests the board should

serve and how the board should be organised. According to Rosenstein and Wyatt (1990), the proportion of outside directors affects shareholder return. Crystal (1991) and Jensen (1993) point out that boards fail to be effective typically because boards are too large, the CEO and the board chair are frequently the same person and outside directors are controlled by the CEO. Conyon and Peck (1998) run comprehensive tests on the effects of board size on firm performance in five European countries (UK, France, Netherlands, Denmark and Italy). Their panel data analysis detects a negative correlation between corporate performance and board size in all countries if firm performance is measured by return on equity, supporting Jensen's view. Yermack's (1996) findings also show that corporate value and performance are negatively correlated with board size. Cyert et al. (2002) comprehensive tests on various characteristics on the board structure highlight importance of board ownership which impact on board control potentials is estimated to be more significant than the impact of board size. Core et al. (1999) provides evidence that the severity of the agency problem depends on board structure and governance. Namely, separating the role of CEO and chairman, adoption of *nomination and remuneration committees* consisting of non-executive and, preferably, independent directors is considered as representing best practice (Cadbury Report, 1992).

Zajac and Westphal (1996), with data on 491 directors from Forbes and Fortune 500 indices, found that powerful top managers prefer to fill their boards with members with experience in other passive boards and exclude individuals with experience in more active boards. Therefore, it may be hypothesised that powerful CEOs tend to form "easy-to-govern" boards. *Nomination committees*, if independent of CEOs, control the quality and composition of boards, preventing CEOs, for example, from abusing their power and forming "easy-to-govern" boards. However, every protective mechanism may sometimes be bypassed, and this study finds that some CEOs in top UK companies (especially those with dual roles on the board) are found also to be heads of nomination committees, which, of course, makes such committees inferior as governance institutions. Delegation of the board's responsibility for determining the

remuneration of top managers to independent non-executives in *remuneration committee* should make rent extraction by opportunistic managers more difficult. Indeed, Conyon (1997) reports with UK 1988-1993 data that remuneration committee adoption leads to lower (i.e. more controlled) growth in top executive compensation. Bebchuk et al. (2002) remarks that remuneration committees are now established by boards of "essentially" all large US public companies. The same result holds for 1998 UK data analysed in this study (only 1 out of 204 companies in our FTSE 350 sample does not have remuneration committee).

- *Internal systems of monitoring and control* are also considered as an essential component of corporate governance (Blair, 1995). These systems are obviously supposed to deal with the asymmetry of information in modern corporations. The information available for managers, shareholders, and other stakeholders are different. Customers know more about their tastes than firms, firms are more informed about their costs than government, and all agents take actions that are at least partly unobservable. Certain legal arrangements have been developed to oblige the managers and boards to disclose all relevant information publicly. Internal measurement and control is often more sophisticated than is legally required. It frequently includes monitoring of managerial decisions, personal evaluations and promotion plans. Walsh and Seward (1990) point out two main functions of internal control: to identify the amount and quality of managerial effort and draw inferences about the overall ability of top management.
- *The market for corporate control* is the market for the firm's shares which can be used to apply controls to the firm without management approval. Marris (1964) and Manne (1965) hypothesised that management may be disciplined to work effectively through a threat of hostile takeover in case of managerial failure, which would probably cost top management their positions, pay and reputation. Since the 1980s, cases of leveraged takeovers of public companies without managerial approval became quite common in the US and UK, and despite various defence mechanisms which management can potentially use against takeovers, the market for corporate control is reported to be active (Coates, 2000) and playing an important monitoring role (Fama and Jensen, 1983b).

Researchers admit however that, both in theory and in practice, hostile takeovers are risky and costly for raiders. Grossman and Hart (1980) show that shareholders of the target firm may enjoy most of the gain from the takeover, reducing incentives for the raider. Disclosure laws and insider trading laws may further reduce the probability of a successful takeover, since they alert the management. Moreover, in practice poor performing firms do not seem to bear more chances to be targeted than an average firm (Schwert, 2000). Indeed, firm size seems to be a more significant explanatory factor for takeovers than firm performance (see Schwert, (2000) with US data and Franks and Mayer (1996) for the UK). Bebchuk et al. (2002) argue that, due to the substantial costs of takeover transactions, the market for corporate control is very imperfect and therefore "not strong and fine-tuned" to discipline managers on its own.

- *The market for managerial labour* is viewed as promoting the alignment of the interests of top executives with those of shareholders by tying managerial career prospects to their past performance with other firms (Fama, 1980). It is argued that more talented and committed managers would be recognised and rewarded by efficient executive labour markets with higher and better-paid positions in larger firms. Conversely, managerial failure and poor firm performance would result in compensation revisions and possible downgrading in job responsibilities, i.e. long term, *ex post* settling-up (Fama, 1980). Empirical evidence supports, in general, the view that poor firm performance increases dismissal risk and forced turnover of top management (Warner et al. (1988), Weisbach (1988)). However, the authors admit that associated increase in turnover in underperforming firms is insignificant unless firm performance is extremely bad. Acknowledged market imperfections in acquiring and interpreting information related to managerial quality may provide an explanation for these findings (Jensen and Murphy, 1990).

While acknowledging these limitations, the market for managerial labour seems to be powerful enough to make the managers aware of the general market compensation trends and the "outrage" (Bebchuk et al., 2002) that their personal compensation may generate if it deviates from the trend (with potential damage

to their reputation and career). One of the tasks of independent remuneration consultancy firms often hired by boards' remuneration committees, for example, is to advise the board on the latest market trends and figures.

Although the tightness of this outrage constraint restricts managerial discretion over their pay, powerful CEOs, enjoying the luxury of passive, cooperating boards, may feel confident in exceeding average market trends for managerial pay if firm performance is adequate (see the related "support or fire" model, Bebchuk et al., 2002). Controlling board dynamics, for instance, through chairing boards' nomination committees, CEOs may feel more secure against shareholders' outrage when lobbying for more pay.

- *Executive compensation systems* are another mechanism of corporate governance, in certain circumstances compensating for inadequate existing systems of costly monitoring, measurement and control. It is well known that the majority of publicly traded companies in the US and UK can be characterised as having dispersed shareholders. Large number of small owners have weak incentives to monitor managerial decision making, since each shareholder may try to free-ride in the hope that others will do the monitoring (Hart (1995)). In addition, total monitoring costs for dispersed shareholdings are high, even if all shareholders agree to set up some joint monitoring mechanisms.

In these cases, the design of executive compensation packages can compliment and, indeed, partially substitute for direct methods of managerial control. Agency theory suggests that the structure and value of the managers' pay packages influence their preferences and can be used to gain some control of the firm's decisions indirectly. The executive compensation issue is particularly important for the firm's strategies, since strategic decisions made by top executives are complex and nonroutine (Grossman and Hart, 1983; Hoskisson and Turk, 1990). Researchers argue that the direct monitoring and supervision of managerial inputs are not suitable for nonroutine tasks, while output-based penalties and rewards such as performance-based compensation become more appropriate. This all points to the incentive role of the executive reward package and options in particular.

The following sections of the literature review therefore focus on executive compensation as an important governance mechanism in a modern corporation. We have to bear in mind, however, that all mechanisms designed to control for agency problems are in practice interdependent and their empirical effects on firm performance should ideally be analysed simultaneously to avoid the problem of misspecification (see Agrawal and Knoeber 1996).

Walsh and Seward (1990) emphasize that internal control mechanisms available to the board of directors (e.g. monitoring, evaluation and control, incentive contracts) and external (market based) ways to apply controls to the firm without management approval are *complementary* response alternatives to the principal-agent problem. The business, legal and cultural environment presets the quality of external forces which help to control for managerial self-interest. Any additional reduction in agency cost which is due to the quality of internal corporate governance mechanisms could be considered as complementary.

Interdependency among internal corporate governance mechanisms is potentially even more complicated. All internal governance mechanisms discussed above target managerial opportunism and are generally costly to the firm, and in this regard may be viewed as *substitutes* for each other. Potential substitution effects between different corporate governance mechanisms are hypothesised and empirically tested for in a number of studies, see Rediker and Seth (1995) as an example. Under traditional economic assumption of diminishing returns to any particular mechanism, and the absence of a single dominating mechanism (in terms of efficiency), an efficient corporate governance system would optimally blend the above mechanisms to minimise total agency costs. The "weights" with which separate mechanisms are blended would naturally depend on their relative efficiency under particular economic and other contingencies. Different circumstances could produce different optimal solutions, e.g. different mix of control options and incentives. This may result in empirical (associative) *complementarities* between some of the mechanisms, if economic circumstances or particular type of ownership structure favour or disfavour them in combination. That is, different mechanisms may be driven by the same underlying factors.

For example, in response to opportunistic managers, shareholders could find it optimal to tighten up *all* existing corporate governance mechanisms. Hoskisson et. al. (2002) provide evidence that institutional investor type dominating the firm's ownership affects both the power of managerial incentives and the board composition (proportion of independent outside directors), giving rise to empirical complementarities.

In addition, complementarities may occur when the adoption of governance mechanism A increases the efficiency of mechanism B. For example, passive boards with weak control over managerial power in relation to executive compensation are unlikely to produce and maintain efficient incentive contracts in practice (Bebchuk et al., 2002). Bertrand and Mullainathan (2001) run tests on CEOs being rewarded for "observable luck" beyond CEOs' control (e.g. positive industry or currency shocks). As argued by agency theory, an efficient contract would filter out such shocks and not reward CEOs for mere luck that they cannot influence. The key finding of Bertrand and Mullainathan (2001) is that better governed firms (as measured by board size, board structure and activity of large shareholders on boards) pay their CEOs less for luck, supporting theoretical conjectures. In other words, executive pay practices and other governance mechanisms interact.

The review scrutinises the various questions that are usually discussed in the literature and argues that there is a need for a more accurate and detailed analysis of the executive compensation system. In spite of all previous research, many questions remain unanswered. For example, does market-based compensation always lead to moderation of the agency problem? Can it even exacerbate agency problems by giving opportunistic managers another opportunity to extract rents? Under managerial discretion over firm risk, in what conditions may volatile and unhedged shares and options tie managerial interests to the objectives of shareholders since it is widely assumed that managers are risk-averse and shareholders are risk-neutral? Indeed, shares and options in executive pay packages expose managers to share-price volatility and result in more uncertain total compensation. Does this lead to further misalignment of executives' and shareholders' preferences over firm risk if uncertainty is high?

2.2 The Roots of Agency Theory

Agency theory has been a dominant approach to research on relationship between managers and shareholders for the last 25 years. Agency theory and the principal-agent framework, most widely utilised in the literature, is as a branch of contract theory or so-called "economics of information". Contract theory considers relationship between an "informed party" and an "uninformed party" under various circumstances and suppositions. This "economics of information" emerged as a result of some of the critique of the standard neoclassical theory which supposes that all efforts and costs in the economy is publicly available information and, basically, treats a firm as a highly efficient and well-informed "black box". Contract theory departs from this assumption by supposing that some of the costs and efforts is private information, which is somewhat more realistic assumption. All agents of contract theory are privately informed which inevitably creates implicit market for information. Based on its assumptions on non-uniform distribution of information, contract theory can be used as a tool to analyse the relationships among different parties of stakeholders that constitute the modern corporation, and cover areas where neoclassical theory is ineffective.

Salanie (1997) gives a comprehensive classification of asymmetric information models that are developed in contemporary contract theory:

Table 1. Classification of Contract Theory Models with Asymmetric Information
(adopted from Salanie (1997))

Model	**Description and examples**
Adverse Selection Models	Uninformed party is imperfectly informed of the characteristics of the informed party ("hidden information"); uninformed party moves first. Examples: a seller and a buyer; insurance industry.
Signalling Models	Uninformed party is imperfectly informed of the characteristics of the informed party ("hidden information"); informed party moves first. Examples: Labour market with education as a signal; Market for second-hand cars.
Moral Hazard Models	Uninformed party is imperfectly informed of the actions of the informed party ("hidden action"); uninformed party moves first. Examples: An owner and a manager; Performance-based managerial compensation;

The principal-agent framework utilises mainly moral hazard models. The uninformed parties in principal-agent models are called principals and are leaders, since they move first, proposing a contract. The informed parties are agents and are followers accepting or rejecting the contract. An adequate contract should get the most out of imperfect, or somehow distorted information available to the leaders to increase leaders' expected utility as much as possible, leaving the followers with their reservation utility.

Starting with pioneering paper by Ross (1973), agency theory, which unites all moral hazard models, has been primarily concerned with the relationship between managers and shareholders. Hill and Jones (1992) make a conceptual attempt to generalise core definitions of principal-agent framework on all management-stakeholder contracts, and call that generalisation "stakeholder-agency" theory. Hill and Jones consider contractual relationships between all stakeholders within a firm, leaving for the management the unique and central role of being the only party who enter into a contractual relationship with all other stakeholders. Hill and Jones emphasise that

"*If uncorrected, the divergence between management and stakeholder preferences with regard to the way in which a firm allocates its resources will result in a failure of stakeholders to maximise their utility.*"

That phrase may be viewed as a definition of a generalised agency problem and, simultaneously, a definition of managerial action as a generalised investment or allocation of firm resources.

While acknowledging this broad vision of corporate governance and related issue of a certain amount of social responsibility which should normally be carried by any (not only public) company in addition to paying its taxes, this thesis focuses on the narrower (finance) definition of corporate governance traditionally applied to the Anglo-American context. Public company is viewed here as a shareholder-managed agency with shareholder value maximization being its main objective. Accordingly, firm performance is viewed further through shareholder's lenses with market to book ratio and share price movements serving as main external proxies for the quality of managerial actions. This

Anglo-American view is known as *stock market capitalism* (Dore, 2000), as opposed to the stakeholder-based *welfare capitalism* of Germany and Japan.

2.3 Optimal Contracts for Management and Informativeness Principle

We begin with the assumption that management actions in public companies are not observable and, therefore, not controllable by shareholders. The lack of control for management actions together with conflict of interests creates an agency problem. Agency theory proposes the contractual relationship as a tool to mediate loss in shareholders' utility arising from this agency problem. However, even under an optimal contract some divergence between management actions and shareholders' interests may remain. The reason for this is clear: any contract designed by a partially uninformed party can hardly be perfect. Thus, shareholders at best can only design what is known as a "second-best" contract, a contract, optimal only to the extent of information available to them.

Since direct information on management actions is unavailable, any assessment of management performance, which should be carried out in the contract, should be based on all indirect ("imperfect") information available, such as market-based and accounting-based measures. Any indirect information is likely to be "noisy", distorted or even biased. The residual utility loss under the "second-best" contract can be viewed as shareholders' costs of being uninformed. That constitutes the informativeness principle in agency theory studies:

> Better informed (on management actions) principals are able to design better contracts leaving them with greater utility. (Holmstrom (1979))

Banker and Datar (1989) and Lambert and Larker (1987) study how to aggregate different informative signals of a different quality (e.g. measured by "signal to noise" ratio) into a single measure of the quality of management actions. Holmstrom (1982), with the relative performance evaluation hypothesis, argues that performance measures relative to a peer group bear lower systematic risk and, thus, are more informative and precise.

If the shareholders possess enough professional knowledge to assess management actions directly, they can design "first-best" contract with zero residual utility loss, eliminating the agency problem completely. The "first-best" contract would take a form of a strict code of rules directing managers in their decision-making process, leaving no possibility for them to show their professional skills, intuition or preferences. Any deviation from that strict code would be severely penalised. Under the "first-best" contract, the managers would actually cease to be managers, and shareholders would use managers as "robots" strictly following prescribed rules and routines.

In reality, senior managers' knowledge of their industry is usually superior to that of dispersed shareholders or other stakeholders. Thus, it is unwise for the principals not to exploit the knowledge, skills and intuition of managers. "Second-best" contracts do not control for managers' every step and give some freedom for managers to show their potential.

Overall, this section highlights shareholders' costs of being uninformed parties and emphasises that optimal contracts should be designed on the basis of all signals (within shareholders' reach and ability to analyse) that may bring information on the quality of actions chosen by the management.

2.4 Why Do Shareholders Need Corporate Governance?

If solution to the conflict of interests in modern public companies lies within a properly designed contractual relationship between shareholders and managers, why bother with various corporate governance mechanisms? The short answer is that in a real world:

a) Contracts are incomplete since contracting costs may be large; and corporate governance is concerned with residual rights of control over the firm's assets

b) Corporate governance mechanisms help to gather information on managerial actions, creating a more informative environment for shareholders in accordance with the informativeness principle

In reality, as Hart (1995) points out, optimal contracts are likely to be so ridiculously complex that the transaction costs of designing, negotiating and enforcing them must be immense. As a result, contracts do not specify obligations in all possible future states of the world and, therefore, are incomplete. Based on this, Hart concludes that corporate governance is just a tool to manage situations and issues that are not covered by contracts (for example in some cases of managerial power abuse and opportunistic behaviour).

This thesis argues that there is at least one more role for corporate governance in a modern publicly traded company. Many of the corporate governance mechanisms, such as annual shareholder meetings, boards of directors, elected independent directors, etc, help to gather and regularly update information on management actions. These governance mechanisms are additional (internal) channels of information for shareholders, and a significant supplement to external channels available to shareholders (e.g. firms' market value, accounting reports). Thus, corporate governance helps to create an informative environment, which, as we know from the previous section, benefits principals.

2.5 How Much Does Executive Compensation Cost the Firm?

Any attempt to judge the efficiency of contracts requires information on the costs and benefits involved. The company's cost of providing executive compensation comprises the company resources that are spent to cover the compensation contract, and this is important to any assessment of agency issues. The value of market-based compensation is a stochastic variable and depends on share price behaviour as well as executive behaviour, therefore the costs and benefits of realised market-based compensation cannot be predicted precisely. There are however methodologies that try to estimate the expected value of the company's cost of option grants.

The best known method of valuing stock options is the Black-Scholes formula. To calculate the value of an option, Black and Scholes (1973) exploited the shareholders' possibility to hedge. Since shareholders are generally free to trade and hedge risky assets on the market, and one can consider shareholders as risk-neutral agents. This assumption of risk-neutrality of outside investors is fundamental for modern option pricing theory, and widely accepted methods of valuing stock options are entirely based on it.

Consider a share portfolio we can buy today, which will give the same payoff in the future as an option, called the "hedge portfolio". The value of the "hedge portfolio" represents the expected cost of the option to the firm, and thus equals the option value. According to Black and Scholes, the "hedge portfolio" comprises firm's shares and borrowed risk-free bonds. Therefore, it is possible to find the value of the option by taking off the value of borrowed bonds from the value of shares in the "hedge portfolio".

There are two widely used modifications of the Black-Scholes model in the literature: with continuous and discrete time. Each of the modifications has certain advantages and disadvantages. Continuous models lead to an explicit solution for the option value as a function of exercise price, expiration term, grant-date stock price, dividend yield, stock-price volatility and risk-free interest rate. It is this explicit solution that is commonly referred to as the Black-Scholes formula.

However, the formula is correct only if the option is held until the expiration date. In reality, options can always be exercised long before the expiration date, usually in three or four years after the initial grant. Moreover, theory suggests that early exercise can be an optimal strategy for risk-averse managers in the presence of dividends. This is supported empirically: Hemmer, Matsunaga and Shevlin (1996) notice that executives do tend to exercise their options long before their expiration dates, and this apparently restricts the accuracy of the continuous model.

The Black-Scholes model with discrete time is also called the Binomial Pricing Methodology (Cox and Rubinstein, 1985; Abowd and Kaplan, 1999). As implied by the model's title, the model considers discrete time steps with share prices having two possibilities for the next period. The Binomial Pricing Methodology uses a dynamic programming framework and does not lead to the explicit solution. Hence, the presence of discrete time allows researchers to analyse the opportunity to exercise options early. Moreover, as Black and Scholes showed, components of the "hedge portfolio" can be explicitly found under binomial model.

Using Binomial Pricing Methodology, Abowd and Kaplan (1999) estimate for the US the cost of CEOs' compensation in S&P 500 companies in 1996. The study divides the total cost into five components: salary with annual bonus, options, restricted stock, market-based long term compensation and benefits. Abowd and Kaplan demonstrate that the cost of option grants is the single largest component of the total cost of executive compensation. Although, Abowd and Kaplan do not incorporate the opportunity to exercise options early in their cost estimations, which may lead to an overestimation of option cost, it seems obvious that the modern cost of market-based compensation is high.

2.6 Equity-Based Compensation: Seeming Inefficiency

A few researchers, however, distinguish between the cost to the company of option grants and the value of these options to executives on the receiving end. To keep executives' rewards dependent on company stock price, various time restrictions on hedging company stock and trading options often apply to executive pay packages. For example, executive options are often non-tradable during the first three or four years. As a result, it is not only the human capital of managers (including reputation in the managerial labour market, see Fama (1980)) that is heavily dependent on company performance, but much of their financial capital as well. Unable to hedge risks arising from stock price volatility, executives as risk-averse individuals may feel a significant risk burden. The Black-Scholes formula assumes costless hedging strategies available on the market or risk-neutrality of the agent. Neither of these two requirements holds in the case of executive options, however. One can hypothesise that undiversified executives would value options below their Black-Scholes values (Murphy (1999)).

Although some researchers and practitioners acknowledge the fact that top management tends to value executive share options and other forms of equity-based compensation lower than do the firms themselves, i.e. shareholders, the literature does not fully explore the implications of that phenomenon. One of the reasons why the relevant literature is scarce is that it is generally quite difficult to conceptualise and quantify individual risk aversion. Lambert, Larker, and Verrechia (1991) and more recently Hall and Murphy (2000) are noteworthy exceptions. Lambert, Larker, and Verrechia use the "certainty equivalence" approach to show that option-pricing formulas based on the hedging principle, e.g. Black-Scholes, tend to overestimate the value of non-tradable options for

executives. It should be noted that the same approach may be applied to other forms of market-based compensation: restricted stock in the USA and Long Term Incentive Plans in UK. Hall and Murphy also employ the "certainty equivalence" approach and explore some further implications of the risk-adjusted valuation of executive options. Hall and Murphy's analysis shows that managerial risk aversion may explain, or at least provide an intuitive understanding of almost every aspect of option design and associated executive behaviour:

- Choice of option exercise price
- Option vesting period, including the rationale for the short vesting period practice that is usually observed
- Observed tendencies on the part of executives to exercise options well before expiration
- The industry distribution of observed levels of executive pay, i.e. while the company cost of executive pay is significantly higher in more volatile industries, the risk-adjusted values are relatively stable across industries

This thesis develops and extends the "certainty equivalence" framework. Since financial assets (options and shares) granted to executives are more valuable to companies than to executives, for such transactions to make commercial sense, the difference in valuation must be made up for, at least, by improved company performance. New incentives for value creation represented by these options and shares should be strong enough to outweigh the seemingly inefficient transactions. This logic brings us to the issue of incentives. How do we measure incentives? Do incentives matter?

2.7 Are Executive Pay and Firm Performance Correlated?

Conyon et al. (2001) provides evidence that half of all UK based public companies now operate some type of share-based compensation scheme. Does market-based compensation for executives reduce or increase agency problems? Any answer must depend to some extent on measured pay-performance sensitivity (PPS), i.e. how strong is the correlation between executive pay and firm performance? Pay-performance sensitivity can be used to address agency issues, since it shows the manager's compensation for value creation, though of course the manager may have done little to create this value. However, it has

often been argued that a high sensitivity of remuneration with respect to firm performance and value provides managers with strong *incentives* to increase shareholders' returns. In this respect, the literature typically uses Tobin's q (the ratio of the firm's market value to the replacement cost of its physical assets) and the annual stock market returns on the common stock as alternative indicators of firm value.

Jensen and Murphy (1990) find that pay-performance sensitivity for CEOs in the US was 0.00325 in 1987, i.e. CEO wealth increases by $3.25 with every $1000 increase in firm value. The study considered the responsiveness of CEO stock holding value to the stock price and pay-performance sensitivity coming from annual compensation. Using more comprehensive data, Hall and Liebman (1998) estimated the median pay-performance sensitivity for CEOs in 1994 at $5.29 for every $1000 created firm value, which is considerably greater than in Jensen and Murphy's paper. The major contribution of Hall and Liebman is that they take into consideration precise valuations of managerial option holdings and stock holdings. Value changes in managerial option holdings now add $2.15 to the average CEO's wealth for every $1000 change in shareholder wealth, which covers about 40% of estimated pay-performance sensitivity. Although this estimation is quite crude[2], this finding emphasises once more that stock and option holdings play an important role in modern compensation systems.

It must be admitted however, that all these empirical studies rely on the Black-Scholes formula when calculating the responsiveness of managerial pay to firm performance. As we know from the previous section, the Black-Scholes formula at its best values the company cost of executive share options, whereas an estimation of PPS from the executive's perspective would be based upon the value which executives place on these options.

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[2] Analysing 1985 – 1994 panel data on UK public companies Benito and Conyon (1999) came to the conclusion that the link between cash pay (salary and bonus) of the highest paid director and firm performance becomes stronger over the sample period. This must be kept in mind when comparing 1987 results of Jensen and Murphy (1990) with 1994 results of Hall and Liebman (1998) and estimating corresponding effect of option holdings. True option effect may be smaller than the simple difference between the two due to increased sensitivity of annual bonus to firm performance over time, for example.

Being almost the only exception, Hall and Murphy (2000) emphasise how important it is to adjust the valuation of non-tradable executive share options and restricted shares for risk in order to obtain a credible estimation of PPS. Risk neutral Black-Scholes option valuations overestimate both the value of the options and the level of incentives generated by them. Hall and Murphy show that if executive pay becomes too risky or performance targets (exercise price) too challenging, PPS may actually fall and incentives decline, a somewhat intuitive result which risk neutral option pricing methodologies cannot explain. According to Hall and Murphy:

- Risk-adjusted PPS, as well as option valuation, depends on the overall structure of managerial wealth and the level of its diversification.
- Risk-adjusted PPS is a one-peak function of option exercise price; thus, there is an optimal exercise price which maximises incentives (holding the company cost of option grants constant)

As we can see, managerial wealth is sensitive to firm value not only through the grant of annual compensation (i.e. flow of wealth) but also via stock and stock option holdings (i.e. stock of wealth). Murphy (1999) calls the former the implicit relation and the latter the explicit relation between pay and shareholder wealth. Changes in market-based executive compensation are able to change both implicit and explicit forms of the relationship.

Hall and Murphy's analysis provides a fruitful basis for further research. Being predominantly a theoretical study, Hall and Murphy (2000) leaves many intricate questions opened and untested. Is there any empirical proof that, risk-adjusted or not, PPS is positively linked with firm performance and is a proper indicator of managerial incentives for value creation? If yes, do contemporary practices in relation to managerial pay ensure appropriate levels of PPS? Besides risk-adjusted PPS, what properties of managerial pay and wealth should be taken into account and analysed while testing for the efficacy and effectiveness of compensation systems?

2.8 Evaluating the Efficacy of Compensation Systems

As we can see, empirical studies indicate in the US and UK that market-based forms of compensation became very popular in the 1980's and 1990's. In spite of relatively high

costs, shareholders still continue to provide managers with new option grants. Given this, it seems that there is a strong belief among outside investors concerning the profitability of this practice. It is perhaps surprising that there is little direct evidence that higher pay-performance sensitivities are associated with better financial performance. Advocates of strong pay-performance sensitivity can find some support in the bullish market of the 1980's and 1990's that behaved in a way consistent with their beliefs. However, the causality running between pay and performance is not so obvious for researchers. We can easily imagine that the share market of 1980's and 1990's was driven up by some other factors.

2.8.1 Managerial ownership, unadjusted PPS, and firm performance

In order to track for any positive effects of market-based managerial incentives, the earliest and the simplest approach used in the literature is to study the relationship between managerial ownership and firm performance. In this way, managerial ownership is a proxy for PPS (unadjusted for risk).

Jensen and Meckling (1976) incentive hypothesis suggests that managerial ownership and/or high sensitivity of remuneration with respect to firm performance and value provides managers with strong incentives to increase shareholders' returns through increased effort and closer alignment of objectives of the two parties (e.g. lower consumption of perks by managers and abolition of excessive retention of earnings). Jensen and Smith (1985) point out that due to its forward-looking nature, equity-based compensation and managerial ownership may help to ease possible myopia in managerial investment decisions. However, unrestricted transferability of shares among investors on the open market and necessary hedging restrictions imposed on managerial incentive contracts creates a disparity in actual risk exposure, which prevent this alignment effect to become perfect (Hall and Murphy, 2000).

To let managers hedge their interests in firm equity at shareholders' expense would be a very costly dilution of incentives. If *unhedged*, however, managerial ownership presents a risk-sharing problem. Concept of efficient risk-sharing developed in agency theory explicitly states that, due to managerial risk-aversion, managerial pay should not depend

too strongly on firm performance and associated idiosyncratic risks (Salanie, 1997) as too much pay uncertainty destroys incentives, marginal incentive effect becomes smaller as compensation costs rise and complete convergence of interests never happens. Moreover, we will see in Chapter 3 that managerial discretion over firm risk, hypothesised in this thesis, may even reverse the alignment effect of unhedged equity-based compensation if this type of pay is used too aggressively. Managers with unhedged equity may become too preoccupied with activities reducing firm risk rather than with pursuing positive-present-value projects.

Therefore, it would probably be naïve to anticipate a monotonic and positive relationship between unhedged managerial ownership and firm performance. Demsetz (1983) and Fama and Jensen (1983) have indicated other offsetting costs of significant managerial ownership (both hedged and unhedged) which could further limit the efficacy of high pay-performance sensitivity. Particularly, managers who control a substantial fraction of the firm's equity may have enough voting power to guarantee their employment with the firm at an attractive salary, and may indulge their preference for non-value-maximising behaviour. This entrenchment hypothesis predicts that corporate assets can be less valuable when managed by individuals free from governance over their actions.

The seminal empirical study on the subject was Morck et al. (1988). This study investigated the relationship between management ownership and the market valuation of the firm, as measured by Tobin's Q. Using a single US cross-section for 1980 of 371 Fortune 500 firms, the authors found a significant, non-monotonic relationship between Tobin's Q and management ownership. The work shows that managerial stock ownership (excluding options) in the ranges 0-5% and 25%+ is associated with increases in Tobin's Q. Entrenchment effects may dominate within the range 5-25%.

More recently, Griffith (1999) (with US data) and Short and Keasey (1999) (with UK data) replicated the study using cubic relationships instead of the piecewise linear OLS regressions of Morck at al. The results of Griffith and Short and Keasey broadly confirm the Morck et al. findings. According to all three papers, Tobin's Q first rises, then decreases and then increases again with managerial ownership. Hence, the maximum is reached at 5% of ownership in Morck (1988), at 13% in Short and Keasey (1999) and at

23% in Griffith (1999). As we can see, the results are to some extent inconsistent and seem to be influenced by some additional factors. McConnell and Servaes (1995) used the same cubic relationship and found no evidence of the second turning point. Specifically, they found a positive relation between the performance of firm and managerial ownership in the range of 0-50%. When the ownership is higher than 50%, the ownership/performance relationship is negative.

Other articles have followed the Morck et al. (1988) study. Table 2 summarises the methodology and results of researches that investigated the relationship between managerial shareholding and Tobin's Q.

Table 2. Summary of empirical studies of the relation between managerial shareholding and Tobin's Q

Author(s)	*Sample used*	*Results obtained*	*Comments*
I. Cubic relationship			
Morck et al. (1988)	371 Fortune 500 firms (1980)	0% - 5% - positive 5% - 25% - negative 25+% - positive	The relation is not robust to the use of profit rates as an alternative performance measure
Griffith (1999)	969 firms, majority – NYSE listed (1995)	0% - 23% - positive 23% - 76% - negative 76+% - positive	Only 26 firms, or 2.7% of the sample, have board ownership greater than 50%, due to NYSE listing rules.
Short and Keasey (1999)	Random sample of 225 UK firms listed on LSE	0% - 13% - positive 13% - 42% - negative 42+% - positive	Possibility of endogeneity of managerial ownership is admitted but not tested for.
II. Quadratic relationship			
McConnell & Servaes (1990)	Two cross-sections; 1976 and 1986	0% - 40-50% - positive 50+% - negative	Could not detect cubic relationship

Himmelberg et al. (1999)	Panel data from Compustat 1982-84	0% - 30-40% -positive 30-40+% - negative	Control for endogeneity of ownership with instrumental variables
III. No significant (weak) relationship			
Holderness et al. (1999)	Cross sections for 1935 and 1995	0% - 5% - positive 5+% - no significant relation	Confirmation of endogeneity of ownership structure
Loderer and Martin (1997)	867 acquisitions by US firms, 1978-88	Ownership structure fails to predict Tobin's Q	Simultaneous equation model; endogeneity of ownership structure; Tobin's Q negatively affects managerial ownership
Demsetz, Villalonga (2001)	223 US firms 1980/81	No relation between ownership structure and Tobins' Q	2SLS model; endogeneity of ownership structure; efficiency of market for corporate control

Rosen (1992) remarks that "...Morck et al. (1988) find a curious nonmonotonic relationship between management stock ownership and firm performance... No compelling explanations have appeared as yet for this unusual finding." Indeed, facing this diversity of empirical results, it is not clear whether measurement and/or methodological problems have contributed to this conclusion.

2.8.2 Ownership structure: endogenous or exogenous?

This low degree of consistency of results across ownership-performance studies may suggest that ownership structure is an inherently endogenous variable of market for corporate control, and, therefore, any empirically documented relationship between ownership structure and firm performance is accidental and not reliable. The endogeneity issue in relation to ownership structure represents a very persuasive methodological critique of all single equation models, e.g. those used by Morck et al. (1988) and their followers. Clearly, ownership itself may be influenced by performance.

Demsetz (1983), Demsetz and Lehn (1985) and Demsetz and Villalonga (2001) argue that observed ownership structure, being a product of profit-maximisating shareholder activities, is consistent with maximising firm performance and value and varies across firms because of differences in the conditions facing firms. If this view is valid, the observed ownership structure may be one which approximately maximises firm value under given conditions. Therefore, there is not much sense in attempts to reveal a distinctive relationship between ownership and performance through cross-sectional aggregation, since it is not stable any may be misleading even if it exists.

This study argues, however, that managerial ownership is only partly endogenous. It would be implausible to assume that the market for corporate control is perfect, especially in short run. For example, managerial entrenchment can surely be observed pretty often in the real world, although it contradicts market efficiency. It is argued here that being a powerful driving force in the long run, the market for corporate control still allows managers to pursue their own agendas which do not always coincide with profit maximisation. Having said this, we conclude that managerial ownership has endogenous and exogenous parts relative to our study.

Apart from indistinct causality, the seminal study of Morck et al. (1988) may suffer from another oversimplifying assumption. Tobin's Q and managerial incentives (ownership) are measured and recorded simultaneously, allowing for no lag for incentives actually to make any difference. This would be perfectly sensible thing to do in stable, "equilibrium", conditions. However, both variables under consideration show significant dynamics over time and are far from being stable. Morck et al. (1988) and their followers treat the dynamic ownership-performance system as a static one, unsurprisingly obtaining different results every time.

2.8.3 Introducing dynamics into the ownership-performance relationship

Is the firm's financial performance really influenced by managerial ownership and pay packages? The empirical literature discussed so far used cross-sectional data on

managerial ownership and firm performance documented simultaneously at one point of time. This, unavoidably, raises the causality issue. Ownership structure and firm performance are both unstable, evolving parameters. Proper analysis of the efficacy of performance-based compensation cannot be based on a cross-sectional data at one point in time. In order to analyse the effects of compensation policy and the causality mechanism, research should examine time-series data. However, there is little literature based on longitudinal surveys, with the study of Abowd (1990) being an exception.

Abowd (1990) investigated whether the pay-performance sensitivity of managerial compensation in one year affects corporate performance in the next year. Using 1981-86 data, he considered accounting-based measures of performance as well as market measures. The study provides evidence that an increase in compensation sensitivity to total shareholder return is associated with better market performance in the future, supporting the advocates of performance-based compensation systems.

There are however difficulties associated with the interpretation of Abowd's studies. Most of these difficulties lie in the nature of capital markets. Under the assumption of weakly efficient capital markets, all publicly available information immediately influences stock price. Therefore, an announcement of new stock-based compensation plans has two effects on a firm's market performance: internal and external. The internal effect is an incentive effect on managerial decision-making process, which we intend to address later. The external effect results in share price changes through expectations of higher pay-performance sensitivity. Following the conventional wisdom, market agents expect that managers with new option grants will work more in the interests of shareholders. The forward-looking nature of stock prices might allow the external effect to occur prior to the executive taking any action motivated by the new options. Thus, subsequent stock returns may not show the results of any incentive effect, but rather market expectations of these results. Market expectations are 'noisy' and can clearly be biased in the short run and subsequent stock returns may lead to biased evaluation of the incentive effect. Moreover, executives may adopt option grants in anticipation that the very announcement will raise the stock price. In order to isolate the incentive effect of option grants, Yermack (1997) considered non-publicly announced option grants and found a positive effect for new grants on stock prices.

This thesis employs and develops this "dynamic" view of the incentive-performance relationship. It examines the relationship between market-based compensation for executive directors in FTSE 350 firms (1997/98) and subsequent firm performance. The thesis therefore extends the Abowd (1990) approach, by taking into consideration precise measures of managerial option holdings together with stock holdings as reported in firms' annual reports. Thus, the thesis aims to establish a link between managerial wealth structure and subsequent firm performance, since it is clearly not only the most recent option grants that affect managerial decision-making strategy, but managerial wealth as a whole.

2.8.4 The essential properties of managerial compensation package

To start the incentive-performance relationship analysis, first it is imperative to develop core indices of managerial incentives based on the structure of managerial wealth. One obvious choice would be risk-adjusted PPS, for the reasons discussed in section 2.8. However, it is argued here that risk-adjusted PPS alone does not provide us with all the information we need.

This study suggests that there are two prime properties of managerial wealth (and, in particular, compensation package) which affect managerial decision-making and are crucial in our framework:

- First, the sensitivity of managerial wealth to firm performance (WPS)
- Second, the sensitivity of managerial wealth to firm risk (WRS)

By definition, WPS includes and generalises PPS. Apart from the sensitivity of annual compensation, WPS includes what Murphy (1999) calls explicit relations between managerial and shareholder wealth: the sensitivity of stock and stock option holdings accumulated by the manager. To reflect the level of incentives more accurately, WPS should be adjusted for firm risk, as done in Hall and Murphy (2000) for PPS. Risk-adjusted WPS is a refined indicator of managerial rewards for value creation.

Meanwhile, as we already discussed, there is a theoretical and practical constraint on the incentive effect of WPS, rooted in managerial risk-aversion. Managers have their financial and human capital heavily invested in their own firms and have fewer opportunities to hedge and diversify compared to shareholders. Various restrictions on stock and stock option grants also prevent managers from holding diversified portfolios. Thus, it can be assumed that share price volatility makes it relatively costly for the managers to hold large undiversified equity stakes in their firms. Executive pay packages with large market-based components make managers even more under-diversified and, therefore, the firm's share price volatility may strongly affect the value of total remuneration from the managers' point of view. As a result, projects that appear profitable but risky may seem unattractive to executives who acquire large holdings of shares and deep in-the-money options. In other words, a tight link between pay and performance may impose additional risk on executives.

The purely theoretical paper of Carpenter (2000) considers managers' investment problem if managers are paid with a call option on the assets they control. Carpenter shows that option compensation does not strictly lead to greater risk-seeking. Being aware of share price volatility, managers are more likely to choose a conservative investment decision while shareholders would prefer a more aggressive one. Carpenter emphasises that the managers' optimal volatilities might be less with the option than if they were trading their own accounts. Generally speaking, this fact indicates that managerial interests do not always converge on shareholders' objectives with higher pay-performance sensitivity.

To address this issue, the thesis introduces a new index: the sensitivity of managerial wealth to firm risk (WRS). WRS shows managerial perception towards risky investment opportunities, as induced by their personal wealth.

At any given time, managers face a set of investment opportunities for their firms' resources. Every investment opportunity is, generally speaking, a risk-return trade-off. The two proposed measures (WPS and WRS), analysed together, could help us to sort these opportunities on the risk-return "map" according to managerial preferences, a kind of task, impossible to accomplish relying solely on WPS.

As a proxy for managerial perception towards firm risk we will use ratio WRS / WPS. This ratio reflects relative managerial risk burden and is called risk-reward ratio (RR) in this study. It is hypothesised that if the risk-reward ratio is high, there is an increased chance that managers forgo risky but positive-present-value projects due to increased conservatism in investment appraisals. Empirical tests carried out in Chapter 7 provide some evidence that high levels of managerial conservatism RR may slow or even reverse the alignment of managers' and shareholders' objectives.

2.9 Summary: The Effects and Objectives of Remuneration Packages

This final section of the literature review summarises the essential effects of market-based executive compensation as a governance mechanism and relates these effects to the main objectives of residual-claiming owners.

A detailed causality mechanism that emphasises the role of executive remuneration package is identified in Figure 2. Figure 2 takes on the standard governance-strategy-performance paradigm described in section 1.2 above. It should not be forgotten that the figure shows just one part of a wider picture and does not include a number of important external interactions. For example, following the corporate strategy paradigm, governance may be to some extent endogenous, since corporate ownership and control may be influenced by the firm's past financial performance.

Overall, this review reveals two distinct and crucial effects of market-based compensation on the managerial decision making process.

A) In agency theory, market-based compensation is seen as a mean of increasing managers' *effort*. Under market-based compensation, managers' efforts affect their utility. Therefore managers have strong incentives to increase their efforts and productivity. Simultaneously, market-based compensation makes managerial pay more highly correlated with shareholders' return, forcing managers to act more in the interests of shareholders.

B) Top managers have both the power and the incentive to control firm risk to some extent. Market-based compensation exposes risk-averse managers to share price volatility, imposing additional *risk* on them. Although managerial pay becomes correlated with shareholders' return, risk-neutral shareholders and risk-averse managers may value prospective investment decisions in essentially different ways. The high risk sensitivity of managerial wealth may further decrease managerial risk-seeking and force managers to shift to excessively conservative investment decisions.

The first effect A is positive, it is based on an increase in managers' involvement and is particularly important if the inputs and outputs of managers cannot be cheaply observed and (or) managerial shirking cannot be eliminated more cheaply by monitoring. Effect B however may be negative. It emphasises that market-based compensation might encourage excessively cautious managerial behaviour. If managers were risk-neutral the process of tying managerial pay to shareholders' return would indeed result in the alignment of the managers' and shareholders' objectives. It may not always be the case, since managers are risk-averse.

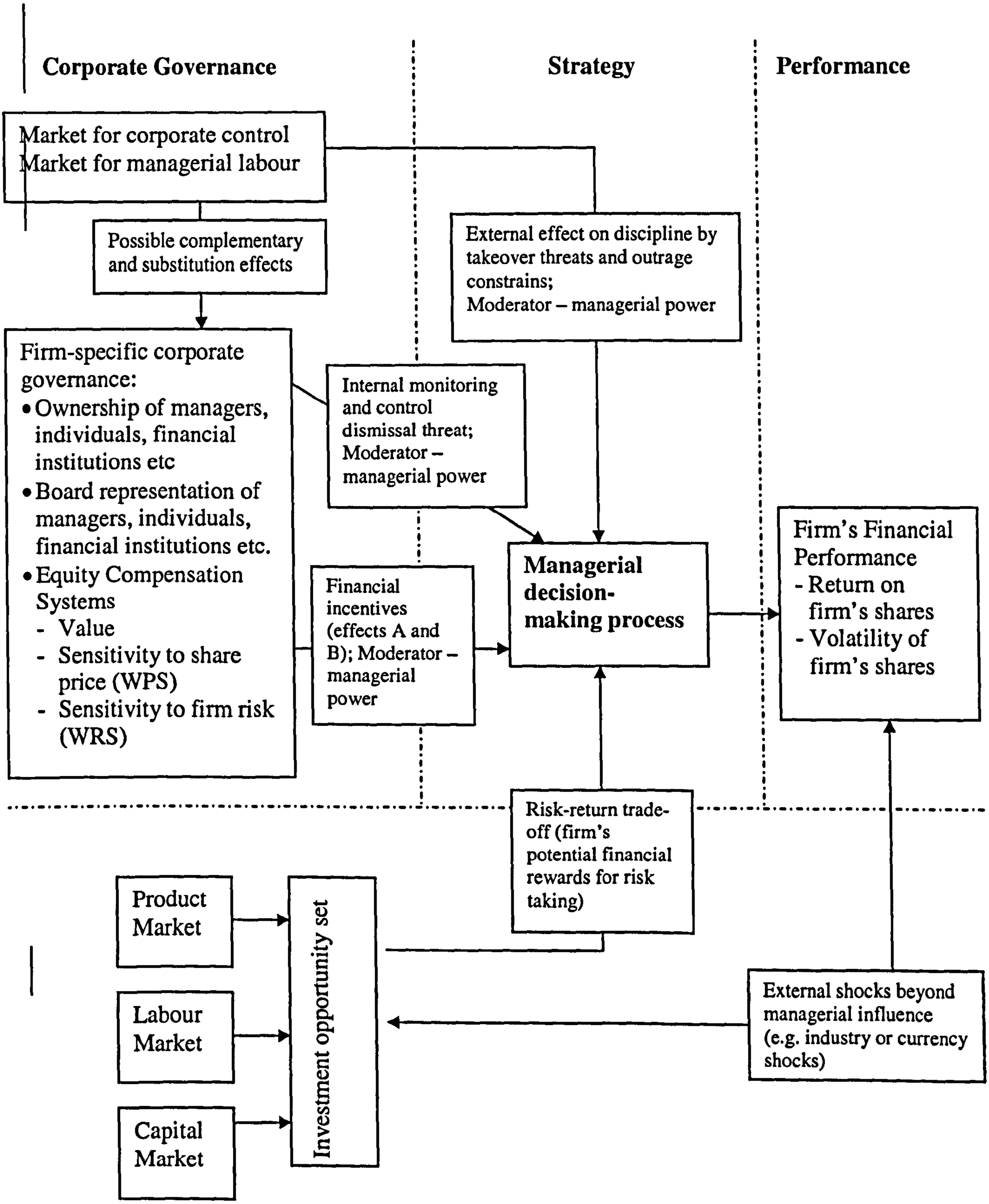
Given these two effects, an optimal compensation system should solve the complicated problem of a simultaneous increase in managerial involvement and aligning managerial risk valuation to shareholders' risk preferences. In other words, an efficient compensation system should provide high rewards for value creation, simultaneously controlling for managerial risk-aversion. For example, while compensation based on shares solves the first problem, the high risk sensitivity of wealth induced by unhedged shares may still prevent aligning managerial actions to shareholders' objectives. This is a well known result of agency theory. Top management agency situation is complicated however with managerial discretion over firm risk, which makes potential effect of managerial risk aversion even more severe. From this perspective, the findings of Morck et al. (1988), McConnell and Servaes (1995), Griffith (1999) and Short and Keasey (1999) of a non-monotonic relationship between management stock ownership and firm performance may provide support for the two distinct effects of market-based compensation.

This thesis develops two indices to measure these two effects. The sensitivity of managerial wealth to firm performance (WPS) is designed to measure positive effect A. Sensitivity of managerial wealth to firm risk (WRS) is designed to measure effect B. As mentioned in this review, all governance mechanisms are potentially interdependent, therefore market-based compensation must be analysed together with other governance variables like board size and structure and managerial power concentration.

Apart from the monitoring, control and incentive effects of corporate governance, Figure 2 emphasizes the importance of firm's investment environment for the research. With significant managerial discretion over firm risk the amount of rewards which firm potentially get or loose in risk-taking activities becomes crucial in designing risk-optimal compensation system. We will see in Chapter 3 with the development of a revised moral hazard model that optimal risk-sharing in an environment with higher rewards for efficient risk taking (i.e. risk-sensitive), such as joint ventures with high growth opportunities, IT and Telecom sectors, may differ from what would be optimal in an environment with low rewards for risk.

The proposed research suggests the design an adequate compensation system through an analysis of the dual effects (A and B) of every perspective component of the system, balancing involvement and risk valuation issues.

Figure 2. Corporate Strategy Paradigm



CHAPTER 3. Theoretical Background: An Agency Problem for Top Management

Agency theory views managerial compensation as a tool to manipulate managerial interests and efforts in favour to the shareholders' objective of value creation. Theory suggests that, if uncontrolled and uncorrected, managers tend to serve their own interests, not collinear with those of shareholders. It is argued further that, for the case of top management, output-based incentive schemes that aim to promote shareholder value may be a less costly and more effective mechanism of corporate governance than traditional forms of monitoring and control. Under equity based pay, managerial wealth becomes correlated with shareholder value, which, as advocates of high pay-performance sensitivity claim, corrects managerial interests and aligns them with shareholders' objectives.

This purely theoretical chapter aims to put this logic into a strict mathematical form by designing an appropriate principal-agent model to describe the agency problem between the firm's outside shareholders and the top management. The main outcome of the model developed in this chapter is that equity based incentive schemes serve indeed well *if implemented cautiously*. Equity based managerial pay affects both the level of managerial job commitment and their perception towards firm risk (Figure 2). Overfeeding the managers with risky assets may undermine the positive involvement effect and result in further deviations of managerial interests from shareholder objectives, especially in relation to risk assessments.

We start with a discussion of a typical moral hazard model with linear incentive scheme which often get empirically tested in the applied studies. Risk-related limitations of the model, relevant for the analysis of the top management agency problem, are identified and discussed. Relaxation of some of these limitations with the development of the revised model with endogenous firm risk is one of the objectives of the thesis.

3.1 The Basic Principal-Agent Model

This section presents and discusses a typical "hidden action" model (Holmstrom, 1979) where a manager takes action, a, and produces stochastic shareholder value, $x(a)$. This

model is widely utilised in the literature and can be found in Holmstrom and Milgrom (1987) and (1991), Aggarwal and Samwick (1999), Conyon and Sadler (2001) as a background for applied studies. The main assumption of the framework is that managerial actions cannot be observed by the shareholders. The shareholders can rely only on realised output *x(a)*, partly a stochastic production function which converts managerial efforts into output and utility for the manager.

In this type of models, the term "effort" is an aggregate of all employee inputs that are not directly observable by the principal-owner. Therefore, all possible sources of adverse effects on value creation which are within managerial influence could contribute to the lack of managerial aggregate effort; including shirking, inefficiency and myopia in risk-taking, consumption of perks, excessive retention of earnings, entrenchment with adverse effects on healthy competition among top managers, etc. The model considers an incentive scheme that ties managerial wealth to resulting shareholder value. The central outcome of the model emphasises the importance of the issue of firm risk to the design of an adequate compensation system.

Given the effort of the manager, a, let the output be $x = x(a) = a + \varepsilon$, where the random term ε represents the uncertainty of the production function and is normally distributed $\varepsilon \sim N(0, \sigma^2)$. The model considers a linear incentive scheme with payoff to the manager in the form:

$$s(x) = \delta + \gamma x$$

The fixed salary δ and pay-performance sensitivity γ of the contract are to be determined by the shareholders in a way that provides the manager with strong incentives to take the desired actions. Suppose that the utility function of the risk-averse manager has an exponential form,

$$U(x) = -e^{-\rho(w - C(a))},$$

where w is wealth, ρ represents the level of risk aversion and C(a) is the convex disutility of effort. Therefore, the expected value of managerial utility is:

$$E(U(x)) \equiv \int U(w) f(w) dw = -\int e^{-\rho(w - C(a))} f(w) dw, \qquad (3.1)$$

where the function $f(w)$ is the probability density function of managerial wealth. Since 'noise' ε in the production function is normally distributed, managerial wealth under the

incentive scheme $w = s(x) = \delta + \gamma x = \delta + \gamma a + \gamma\varepsilon$ has a normal distribution as well: $w \sim N(\delta + \gamma a, \gamma^2\sigma^2)$. Given this, expected value of managerial utility (3.1) can be simplified:

$$E(U(x)) = -e^{-\rho\left(\delta+\gamma a-\frac{\rho\gamma^2\sigma^2}{2}-C(a)\right)} \tag{3.2}$$

Finally, since the exponential function is strictly monotonous, the utility measure (3.2) creates the same ordering as utility measure (3.3):

$$E(U(x)) = \delta + \gamma a - \frac{\rho\gamma^2\sigma^2}{2} - C(a) \tag{3.3}$$

Thus, the managerial problem is to maximise utility (3.3) by choosing the level of effort,

$$\max_a : \delta + \gamma a - \frac{\rho\gamma^2\sigma^2}{2} - C(a) \tag{3.4}$$

given certain salary δ and pay-performance sensitivity γ.

The first order condition gives us $C'(a) = \gamma$. This equation describes the managerial reaction on the incentives created by pay-performance sensitivity. In this simple model the higher the sensitivity is, the higher is the level of managerial effort and created value.

On the other hand, since the shareholders are assumed to be risk neutral, the shareholders' objective is to maximise expected output, a, net of payoff to the manager. This maximisation is performed by choosing the desirable level of effort, a, contract δ and γ which ensure this level of effort and is subject to managerial reaction function and a reservation utility u^* of the manager.

$$\max_{\delta,\gamma,a} : \; a - \gamma a - \delta \tag{3.5}$$

$$\text{s.t.} \qquad C'(a) = \gamma$$

$$\delta + \gamma a - \frac{\gamma^2\rho}{2}\sigma^2 - C(a) \geq u^*$$

The solution of the maximisation problem (3.5) gives the optimal pay-performance sensitivity:

$$\gamma_{opt} = \frac{1}{1+\rho C''(a)\sigma^2} \tag{3.6}$$

The derived equation (3.6) is of central importance. It implies that optimal pay-performance sensitivity declines with the volatility of the output and the level of managerial risk-aversion.

Overall, the basic model described above leads to two hypotheses:

H1a) Managerial effort and the firm's value are monotonic and increasing functions of PPS.

H2a) Optimal managerial PPS is a decreasing function of the variance in the firm's performance and the level of managerial risk-aversion.

Although many studies have tried to test these predictions with applications to top-managers and CEOs, the results are mixed and unclear (e.g. Cyert et al. (1997), Aggarwal and Samwick (1999), Cyert et al. (2002), Core and Guay (2002)). Namely, in practice greater firm risk was found decreasing or increasing the use of profit sharing schemes, which is not consistent with hypothesis (H2a). Evidence supporting hypothesis (H1a) is quite weak as well. Abowd (1990) admits that the results supporting the hypothesis (H1a) have a low degree of precision. Murphy (1999) emphasises that in spite of the belief that market-based compensation will improve managerial incentives and subsequent company performance, "...there is surprisingly little direct evidence that higher pay-performance sensitivities lead to higher stock-price performance".

Contemporary empirical studies use the described model as a theoretical background while examining CEOs' and board members' pay packages and tracking for possible pay-performance relationships. However, as argued in this thesis, this model is not designed for the top management agency problem due to significant risk-related limitations. Indeed, managerial generalized "effort" is not allowed to influence firm risk (and therefore remuneration uncertainty, as one could naturally expect if managers are compensated with shares) in this model. To see this is enough to ensure that standard deviations of firm production risk and compensation payoff both do not depend on managerial action a. Since the term "effort" is used to designate all managerial inputs, it follows that this model

does not account for top managers controlling or influencing firm risk, which seems implausible.

It would be implausible to anticipate that the model that reduces managerial involvement in production process merely to choosing desirable production level and leaves firm risk strictly exogenous could describe preferences and interests of top management accurately enough. Clearly, this model considers agents who set production levels only and have no mechanisms to control or at least influence firm risk; and these assumptions do not hold for top executives. Thus, despite being used quite extensively in applied studies, the basic model described in this section does not appear to provide an appropriate theoretical background for studies of the remuneration of top executives.

The next section discusses detailed reasoning for these arguments. It shows that the basic agency model analyses a case of an average hired worker who has no power to influence firm risk, rather than a top manager. It argues that, if used for top management, the model oversimplifies the managerial reaction function and should be revised. Consequently, hypotheses (H1a) and (H2a) should be revised as well. After the necessary revisions are made, we will see that, with top executives, higher pay-performance sensitivities may not always be expected to lead to higher stock-price performance in theory as well as in practice.

3.2 Managerial Control of Firm Risk

The need for a revision to the basic model may be demonstrated by examining managerial action, as it is modelled, more closely. Doing this, we could determine possible grounds why the basic model is not supported empirically by the pay-performance data on top management.

If applied to top management, model (3.4) and (3.5) portrays managers with a payoff $w \sim N(\delta + \gamma a, \gamma^2\sigma^2)$. It can be noticed that standard deviation of this payoff does not depend on managerial action a. It would imply that the managers do not have any means to control firm risk and, therefore, the uncertainty of their reward.

However, it is apparent that, apart from firm profitability, managerial actions may affect firm risk, for example through various forms of product diversification, forward positions in goods and currencies, and insurance policies of various kinds. The higher the managers are ranked, the greater the impact of their decisions on firm risk may be. Top managers undoubtedly have both the power and desire to control firm risk to some extent.

Hence, to tailor model (3.4) and (3.5) for top executives we have to ensure that our revisions allow for managerial discretion over firm risk, with managerial action viewed, at least partly, as a generalised investment that managers undertake. Top managers define business strategies including debt and equity financing, dividend policy, selecting preferable markets and industries to enter or exit and many other complex issues, all involving major allocations of the firm's resources and affecting firm risk.

Furthermore, our revision has to take into account that empirical evidence suggests that the volatility of more profitable investments is generally higher than the volatility of less profitable alternatives. This result directly follows, for example, from a widely accepted Capital Asset Pricing Model which may be found in almost any textbook on investment strategy (e.g. Rutterford (1983)). The basic model (3.4) and (3.5) ignores this fact with managerial action and firm risk being viewed as two independent factors, and therefore underestimates the role of managerial risk-aversion.

The next section presents the revision to the model described above which assumes more plausible production function and tries to capture the possible effects of managerial control over firm risk. It will be shown that managerial risk-aversion is able to prevent and even reverse the alignment of managerial actions with shareholders' objectives and in this case, high pay-performance sensitivities do not always have a positive effect on firm performance.

3.3 A Revised Principal-Agent Problem

In the revised model proposed in this thesis, the main assumption remains that managerial inputs cannot be observed cheaply by shareholders. Managers take actions that are assumed to consist of investment decisions with return π; all other managerial inputs

unobserved by shareholders are still represented by the aggregate "effort" a, $0 \le a < 1$, producing stochastic shareholder value, $x(\pi,a)$.

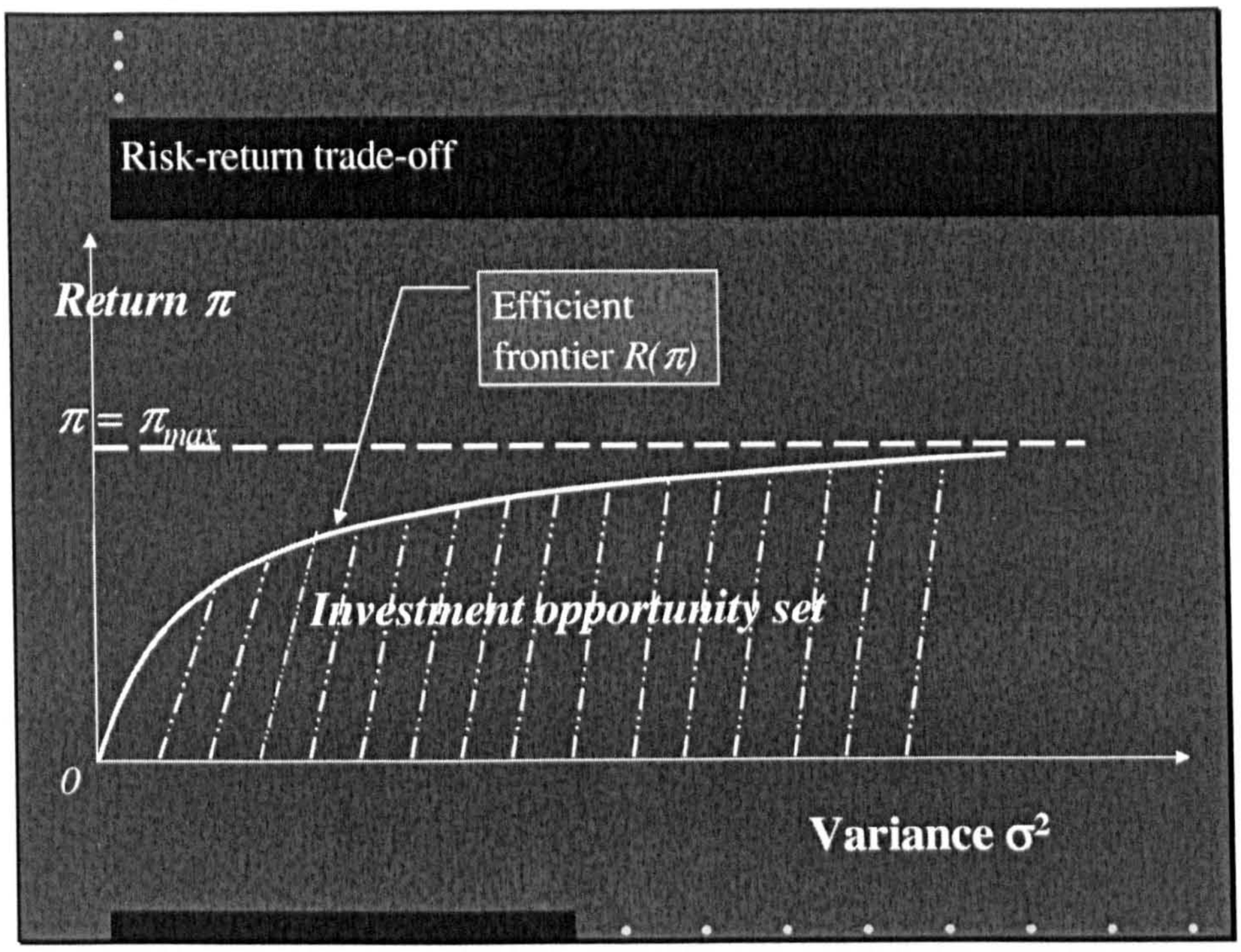
$$x(\pi,a) = a\pi + (R(\pi))^{1/2}\varepsilon$$

Here we aggregate all managerial inputs into an action vector (π, a) and allow the first element of the vector influence firm risk, and the second element be risk-independent. Managerial conservatism in investment appraisals, excessive diversification and "empire building", therefore, adversely affects risk-related element π. Perks consumption, excessive retention of earnings and managerial shirking resulting waste in firm's resources is captured by risk-independent element a.

The 'noise' term ε has standardised normal distribution $\varepsilon \sim N(0,1)$, however in contrast to the basic model the return and volatility of investments are assumed to be positively related, through increasing and convex function $R(\pi)$. Thus, managers may choose between projects of low and high relative volatility and independently determine risk-independent managerial effort that should be spent. Function $R(\pi)$ reflects the risk-return trade-off that managers face and may be seen as an efficient frontier of an investment opportunity set, feasible for the firm (Figure 3). It is assumed here that all feasible investments π in the economy (or industry) are situated between 0 and π_{max} and those close to π_{max} are highly risky. Element a of the action vector is supposed to vary between 0 and 1 and reflects the waste of the shareholders' returns on investments made by the firm as a result of managerial inefficiency in minimizing operational costs , shirking, retention of earnings and other risk-independent sources of waste.

It can be seen that the proposed revision is a direct extension of the basic model in a sense that production function $x(\pi,a) = a\pi + (R(\pi))^{1/2}\varepsilon$ becomes equivalent to $x = x(a) = a + \varepsilon$, once we fix risk-related element π at any given level and leave the managers free to decide on their effort regarding risk-independent sources of waste only. This division of the aggregate "effort" into the action vector (π, a) allows for more accurate modelling of the effects of managerial actions, incentives and risk-aversion on shareholders' value. Risk-independent element of the action vector a is still referred to as "effort" in a sense that it is costly for a manager to maintain high levels of a and low waste of firm's returns.

Figure 3. Investment opportunity set as a risk-return trade-off



The incentive scheme remains as before, $s(x) = \delta + \gamma x$, which generates normally distributed managerial wealth $w = s(x) \sim N(\delta + \gamma\pi a, \gamma^2 R(\pi))$. As in the basic model, managerial equity-based incentives are supposed to be unhedged. However, this model, in contrast to the basic one, assumes that managerial action influences not only the expected managerial wealth but also the level of output, and thus remuneration, uncertainty. Following the design of the previous model, managerial expected utility can be written in the form:

$$E(U(x)) = \delta + \gamma\pi a - \frac{\rho\gamma^2 R(\pi)}{2} - C(a) \qquad (3.7)$$

where $C(a)$ is increasing and convex disutility of effort. Thus, the revised managerial problem is to maximise utility (3.7) by choosing the investment π and the level of effort a, given salary δ and pay-performance sensitivity γ:

$$\max_{\pi,a} : \delta + a\pi\gamma - kR(\pi)\gamma^2 - C(a) \qquad (3.8)$$

where $k \equiv \frac{\rho}{2}$.

It is assumed further that functions $C(a)$ and $R(\pi)$ are of an increasing curvature with properties:

$$\left(\frac{aC'}{C}\right)' > 0, \left(\frac{aC''}{C'}\right)' > 0$$
$$\left(\frac{\pi R'}{R}\right)' > 0, \left(\frac{\pi R''}{R'}\right)' > 0 \qquad (3.9)$$

These properties, in particular, are well suited to a case when managerial choice of a and π is bounded $0 \le a < 1, 0 \le \pi < \pi_{\max}$, with $C(1) = R(\pi_{\max}) = \infty$, which seems to be a plausible restricting assumption on the investment opportunity set and level of effort.

The first order condition for problem (3.8) is

$$\begin{cases} C'(a) = \gamma\pi \\ a = kR'(\pi)\gamma \end{cases} \qquad (3.10)$$

Equations (3.10) describe the rational managerial choice of investment strategy π and personal devotion a to the project, as induced by pay-performance sensitivity. Of critical importance, and contrasting with the results of the basic model, higher sensitivities do not always lead to higher levels of managerial effort and created value. In this model, risk-averse managers may manipulate firm risk to their own advantage. If their equity stakes become too large, value-creating priorities of the managers may be outweighed by value-preserving, but risk-reducing, excessively cautious behaviour.

The next section analyses the managerial reaction function as given by (3.10) in detail.

3.3.1 Managerial response to PPS

In order to understand how the managerial investment strategy and level of effort changes with changes in the pay-performance sensitivity, we differentiate equations (3.10) with respect to γ. As a result, we get a system of two linear equations on unknowns $\frac{da}{d\gamma}$ and $\frac{d\pi}{d\gamma}$.

$$\begin{cases} -C''\dfrac{da}{d\gamma}+\gamma\dfrac{d\pi}{d\gamma}+\pi=0 \\ \dfrac{da}{d\gamma}-kR''\gamma\dfrac{d\pi}{d\gamma}-\dfrac{a}{\gamma}=0 \end{cases} \tag{3.11}$$

Solving this system for $\frac{da}{d\gamma}$ and $\frac{d\pi}{d\gamma}$ we obtain an answer to an important question: how would managerial risk-preference π and the rational choice of effort a depend on the pay-performance sensitivity of their holdings? Then, we could calculate expected shareholder value created by managers as $z = E(x) = a\pi$ and optimise (maximise) it with respect to PPS.

It is convenient to present the solution of the system (3.11) in terms of elasticities,

$$\begin{aligned} e_{a,\gamma} &= \frac{da}{d\gamma}\frac{\gamma}{a} = \frac{1-r}{1-rt} \\ e_{\pi,\gamma} &= \frac{d\pi}{d\gamma}\frac{\gamma}{\pi} = \frac{t-1}{1-rt} \\ e_{z,\gamma} &= e_{a,\gamma} + e_{\pi,\gamma} = \frac{t-r}{1-rt} \end{aligned} \tag{3.12}$$

where z is expected shareholder value $z = E(x) = \alpha\pi$. Parameters t and r are determined by the managers' disutility of effort $C(a)$ and risk-return trade-off $R(\pi)$, that shapes the investment opportunity set.

$$t = \frac{aC''(a)}{C'(a)}; r = \frac{\pi R''(\pi)}{R'(\pi)}$$

Both functions $C(a)$ and $R(\pi)$ are increasing and convex, which implies that parameters t and r are positive. The assumed conditions (3.9) imply that t and r increase with a and π correspondingly. Furthermore, one could notice that formulae for t and r are very similar to that for the coefficient of relative risk-aversion, well known in utility based decision theory. As well as coefficient of relative risk-aversion, parameters t and r measure the local "curvature" of functions $C(a)$ and $R(\pi)$.

Parameter r, therefore, may be viewed as a *coefficient of production saturation with firm risk*, and t is a *coefficient of production saturation with labour factor*. If an equity-based

compensation system induces high levels of both parameters, the managers are both inclined to take necessary firm risk for value creation and are devoted to their duties. As we can see from equations (3.12) it is parameters t and r which define the sign of the relationship between pay-performance sensitivity and expected shareholder value. As shown further, it could have either sign.

Figures 4 and 5 show investment strategies pursued by managers and their job commitment for various levels of PPS and present results (3.12) graphically. Figure 6 depicts the resulting expected shareholder value $z = E(x)$, created by the rational choice of the managers as a function of PPS. Table 3 summarises the results.

The revised model suggests that pay-performance sensitivity may have a non-monotonic effect on both managerial preference for firm risk and on the level of job commitment. As a result, it is proposed that PPS has a non-monotonic effect on expected shareholder value created by managers.

As shown in Figures 4, 5 and 6 and summarised in Table 3, the introduction of equity based managerial compensation is likely to increase both managerial risk seeking and their commitment to the job. Equity based pay makes managerial wealth correlated with shareholders' return, and in this initial stage (with relatively *low PPS*) managers have strong incentives to increase their efforts and productivity of their investment decisions. Both effects positively affect the firm's expected profitability. As PPS increases though, the value-creating priorities of risk-averse managers are at some point outweighed by value-preserving, excessively cautious behaviour. This second stage is a *medium PPS* stage. Additional tranches of firm's shares and options at this stage would still make managers work harder and more efficiently, but managerial risk preferences would simultaneously diverge from that of risk-neutral shareholders. The joint effect of increasing PPS is still positive at this stage and new equity tranches are still justified by the growth in created value, with the divergence in risk preferences being made up by positive incentive effect on job commitment. However, further increase in PPS brings us to the point when increased job commitment cannot hide excessive managerial conservatism in investment appraisals any more. Divergence in risk preferences between risk neutral shareholders and risk-averse top managers becomes apparent, firm's value

starts to decline with PPS, and this characterises the *high PPS* stage. Furthermore, as the model suggests, at very high PPS levels both managerial risk seeking and job commitment may actually decline with PPS (Sector IV on Figures 4, 5 and 6).

Hence, the revised version of hypothesis H1a is of a non-monotonic, one peak relationship between managerial engagement in the firm's equity and firm value.

H1b) Managerial effort and firm's value are non-monotonic one peak functions of PPS.

Table 3. Incentive-induced managerial investment strategies and effort for various levels of pay-performance sensitivity

	Corresponding sectors of Figures 4, 5 and 6	*Managerial risk preference* π	*Rational choice of managerial effort a*	*Expected shareholder value* $z = E(x)$
Low PPS	Sector I $r\,t > 1$ $t < 1$	Increasing $(e_{\pi,\gamma} > 0)$	Increasing $(e_{a,\gamma} > 0)$	Increasing $(e_{z,\gamma} > 0)$
Medium PPS	Sector II $r > t$ $t > 1$	Decreasing $(e_{\pi,\gamma} < 0)$	Increasing $(e_{a,\gamma} > 0)$	Increasing $(e_{z,\gamma} > 0)$
High PPS	Sector III $r < t$ $r > 1$	Decreasing $(e_{\pi,\gamma} < 0)$	Increasing $(e_{a,\gamma} > 0)$	Decreasing $(e_{z,\gamma} < 0)$
	Sector IV $r\,t > 1$ $r < 1$	Decreasing $(e_{\pi,\gamma} < 0)$	Decreasing $(e_{a,\gamma} < 0)$	Decreasing $(e_{z,\gamma} < 0)$

Thus, the model suggests that equity based managerial compensation indeed leads to a moderation of the agency problem if implemented cautiously. Moderate PPS creates a positive sense of involvement among managers, encouraging them to seek out and pursue

more profitable investment opportunities for firms' resources. However, under higher levels of PPS, the risk-related preferences of managers overfed with shares and options might stop and even reverse the alignment of managerial interests away from those of shareholders. In other words, if remuneration uncertainty becomes too high, the value creating preferences of the managers transform into value-preserving, cautious behaviour, not correlated with shareholders' objectives. Additional tranches of the firms' equity to the managers at this stage are not justifiable and give opportunistic managers another opportunity to extract rents.

The model suggests (see Figure 6 and hypothesis H1b), that a certain optimum pay-performance sensitivity exists which maximises the positive incentive effects of managerial involvement in total equity. This optimum level clearly varies from industry to industry, from firm to firm, from manager to manager. In theory, this optimum PPS depends on the managerial coefficient of risk aversion ρ, the managerial disutility of effort $C(a)$ and the investment opportunity set feasible for the firm's resources. Thus, the optimum level of PPS depends on and reflects internal factors (such as ρ and $C(a)$) as well as external factors which the firm faces on the market (investment opportunities, macroeconomic conditions, industry growth and volatility, etc). Therefore, it becomes apparent that optimal equity-based compensation system is not something static, fixed in time, since many of these factors are variable and change constantly. The level of managerial engagement in their firms' equity should ideally reflect those changes when they occur, or even precede them if the changes have been forecasted in advance. The optimal managerial compensation system is a flexible one.

The next section proceeds with developing the revised agency model for top management by formulating the shareholders' optimisation problem, deriving the level of optimum PPS and researching its central properties.

Figure 4. Managerial Choice of Investment π and Level of Effort a (phase diagram)

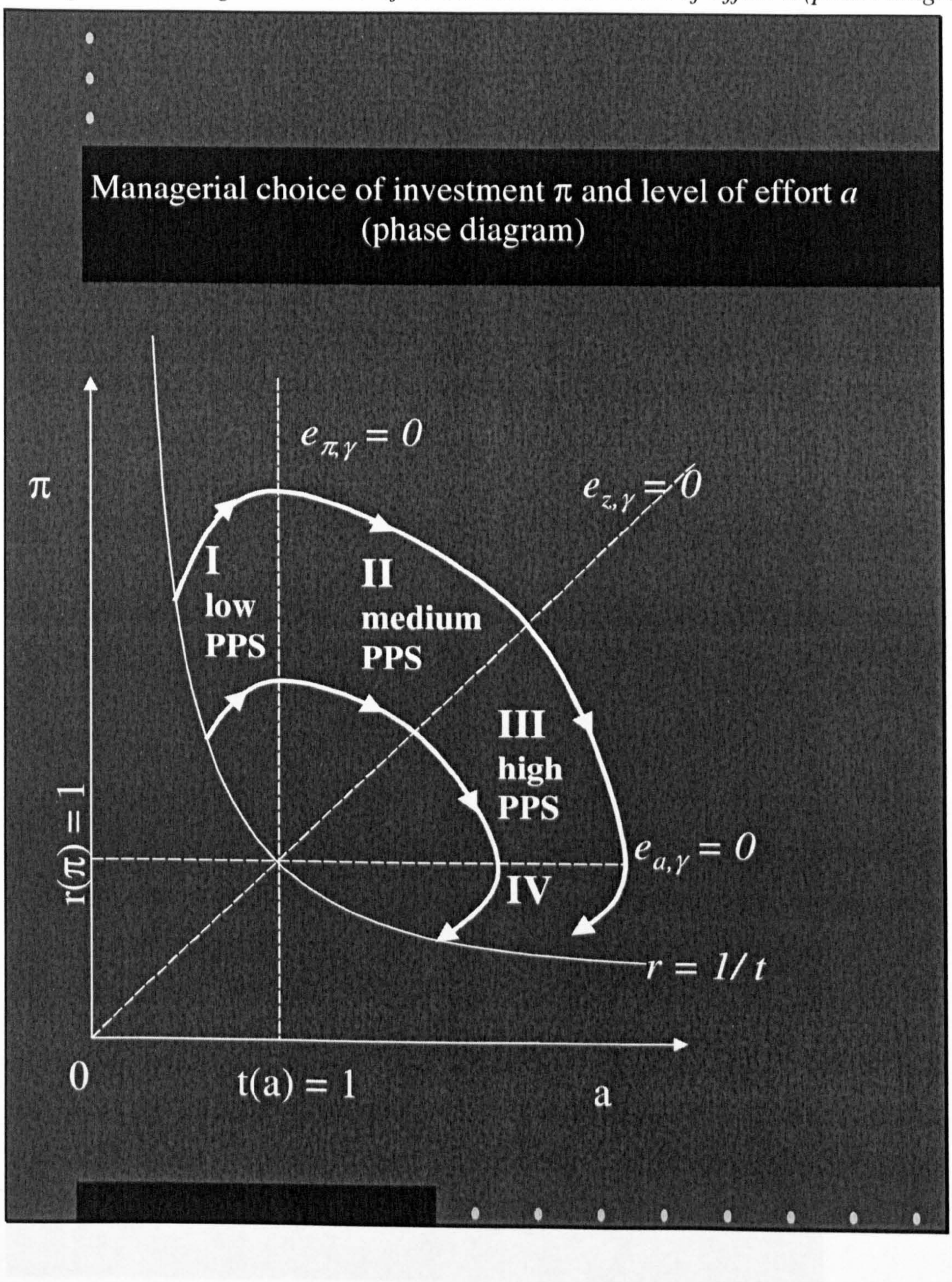
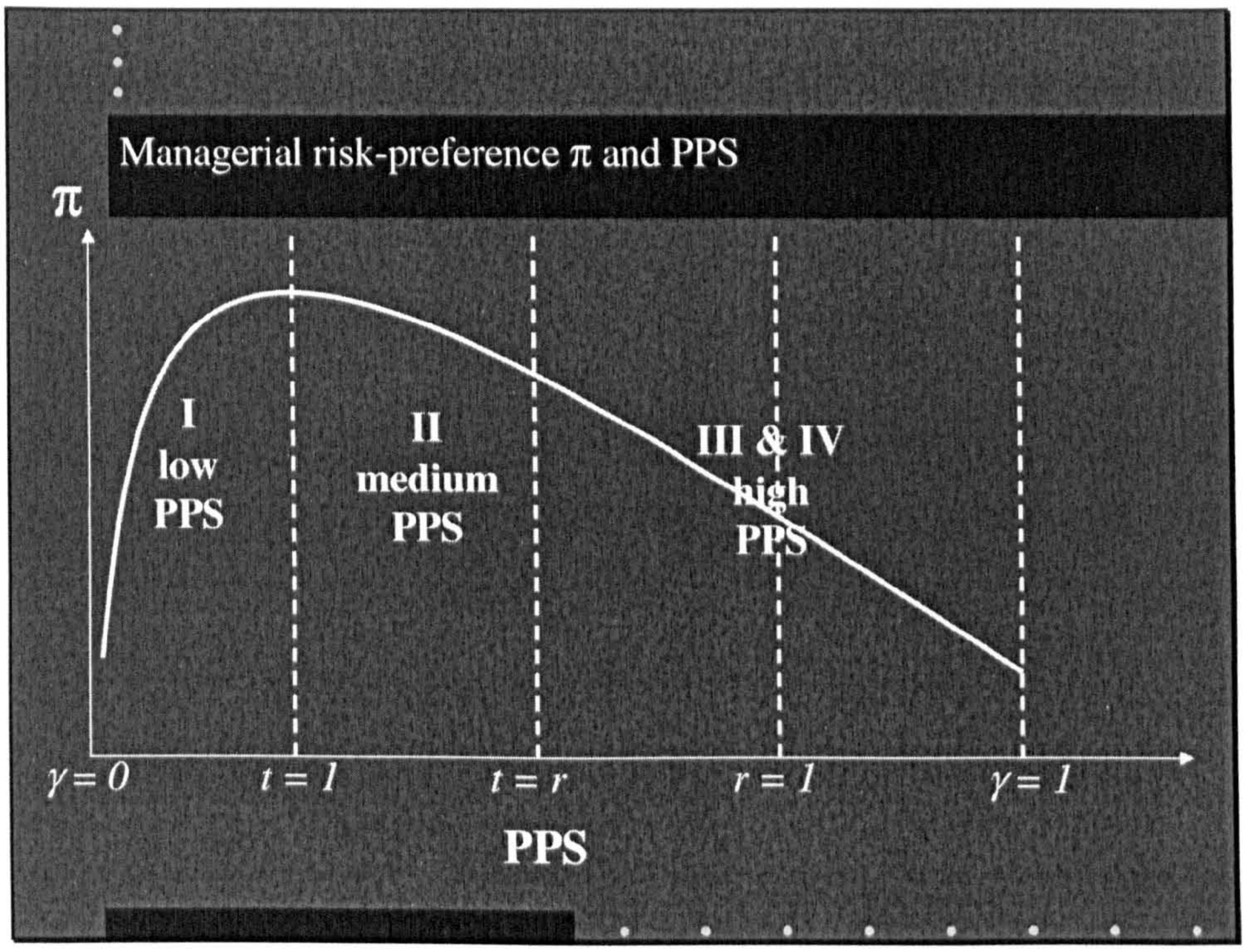


Figure 5. Managerial Choice of Investment π and Level of Effort a as a function of PPS



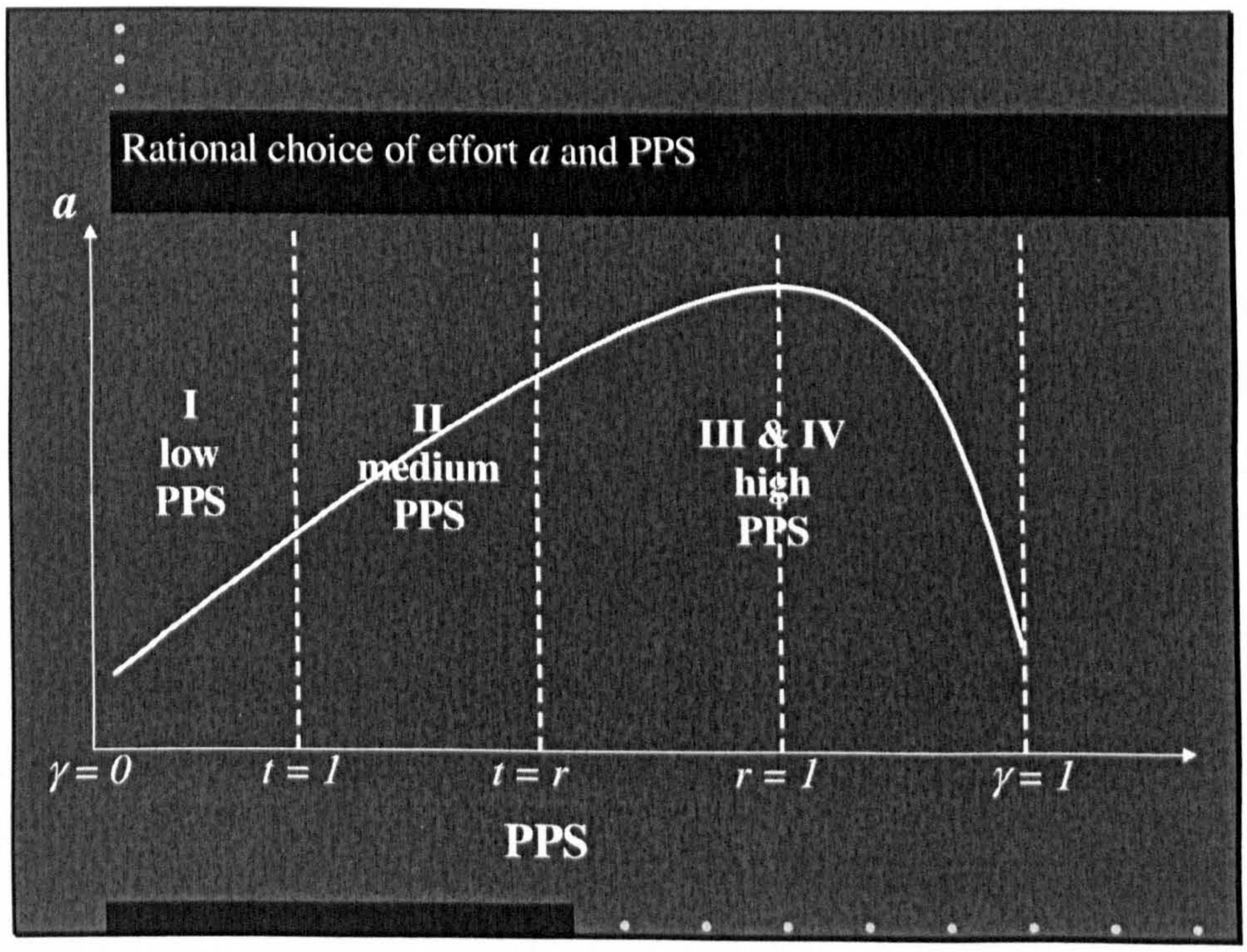
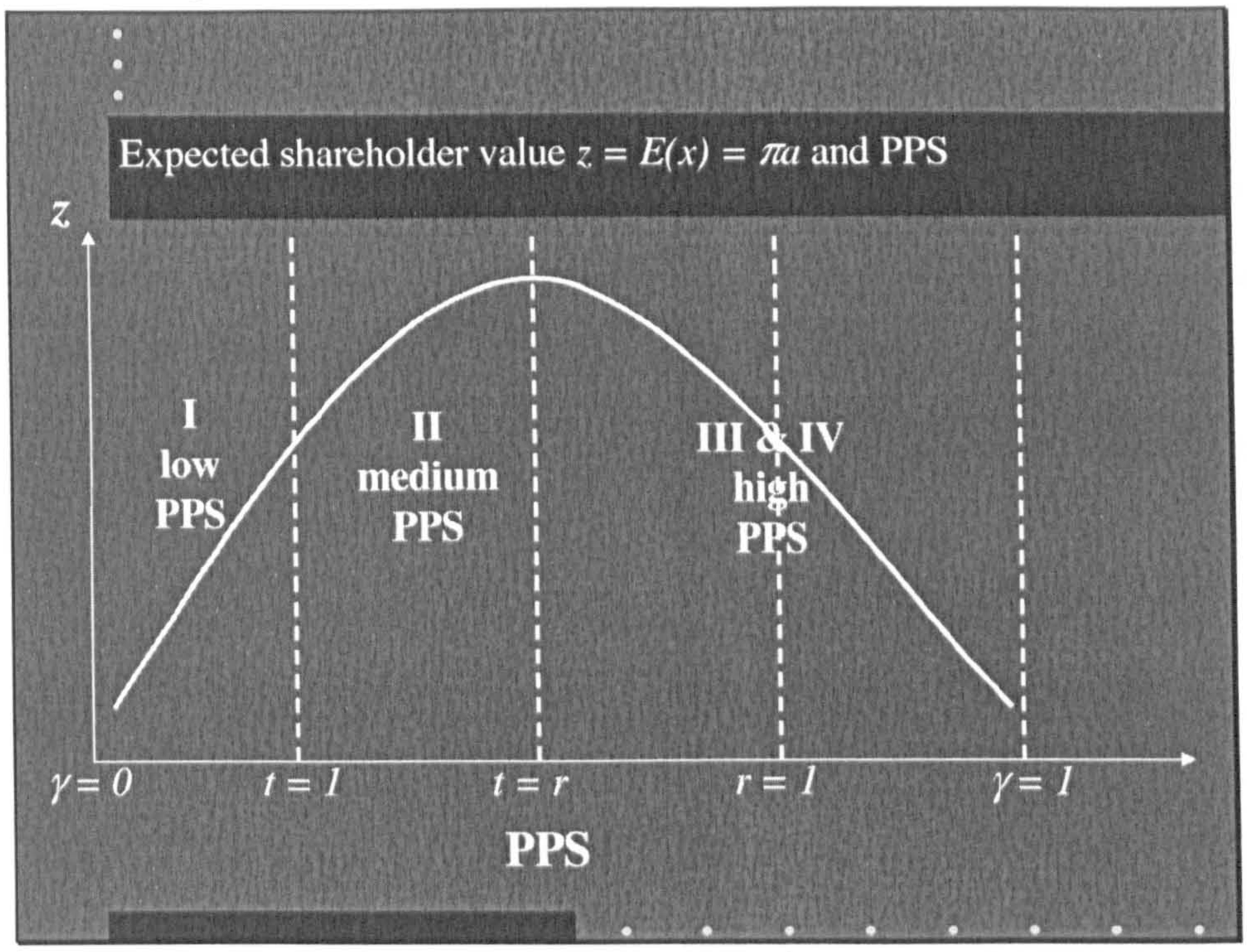


Figure 6. Expected shareholder value $z = E(x) = \pi a$ as a function of PPS



3.3.2 Optimal level of PPS

As in the basic model, shareholders are assumed to be risk neutral. Thus, the shareholders' objective is to maximise expected output, $z = a\pi$, net of payoff to the manager. This maximisation is performed by choosing the desirable investment π and level of effort a, and by designing the contract δ and γ which ensure this choice, that is subject to the managerial reaction function and a reservation utility u^* of the manager.

$$\max_{\delta,\gamma,a,\pi} : \; a\pi - \gamma a\pi - \delta \tag{3.13}$$

s.t.

$$C'(a) = \gamma\pi$$
$$a = kR'(\pi)\gamma$$
$$\delta + \gamma a\pi - kR(\pi)\gamma^2 - C(a) \geq u^*$$

Solving this maximisation problem for the optimal level of PPS (γ_{opt}) yields:

$$\frac{\gamma_{opt}}{1-\gamma_{opt}} = \frac{\nu}{2} e_{z,\gamma} \qquad \text{, where } \nu = \frac{\pi R'}{R}. \tag{3.14}$$

Equation (3.14) is a revised equivalent of equation (3.6). It shows that the optimal level of pay-performance sensitivity lies in Sector II, which we called the medium PPS sector (see Figure 6). As we can see, the right end of the medium PPS sector maximises the firm's expected total value (point $t = r$, implying $\frac{\partial z}{\partial \gamma} = 0$). Interestingly, the outside shareholders' optimum occurs prior to the total value maximisation, when $\frac{\partial z}{\partial \gamma}$ is still positive. It means that, although total expected value, z, still rises at optimum PPS, further increases in PPS are not in the interests of shareholders since z includes managerial equity stakes as well. Thus, the optimal level of pay-performance sensitivity γ_{opt} occurs slightly before total value maximisation.

However, if managers do not possess significant equity stakes, and the optimal level of pay-performance sensitivity occurs for relatively low γ_{opt} without any significant drain of firms' equity resources, we may say that the maximum in Figure 6 depicts the shareholders' optimum accurately enough and equation $\frac{\partial z}{\partial \gamma} = 0$, or

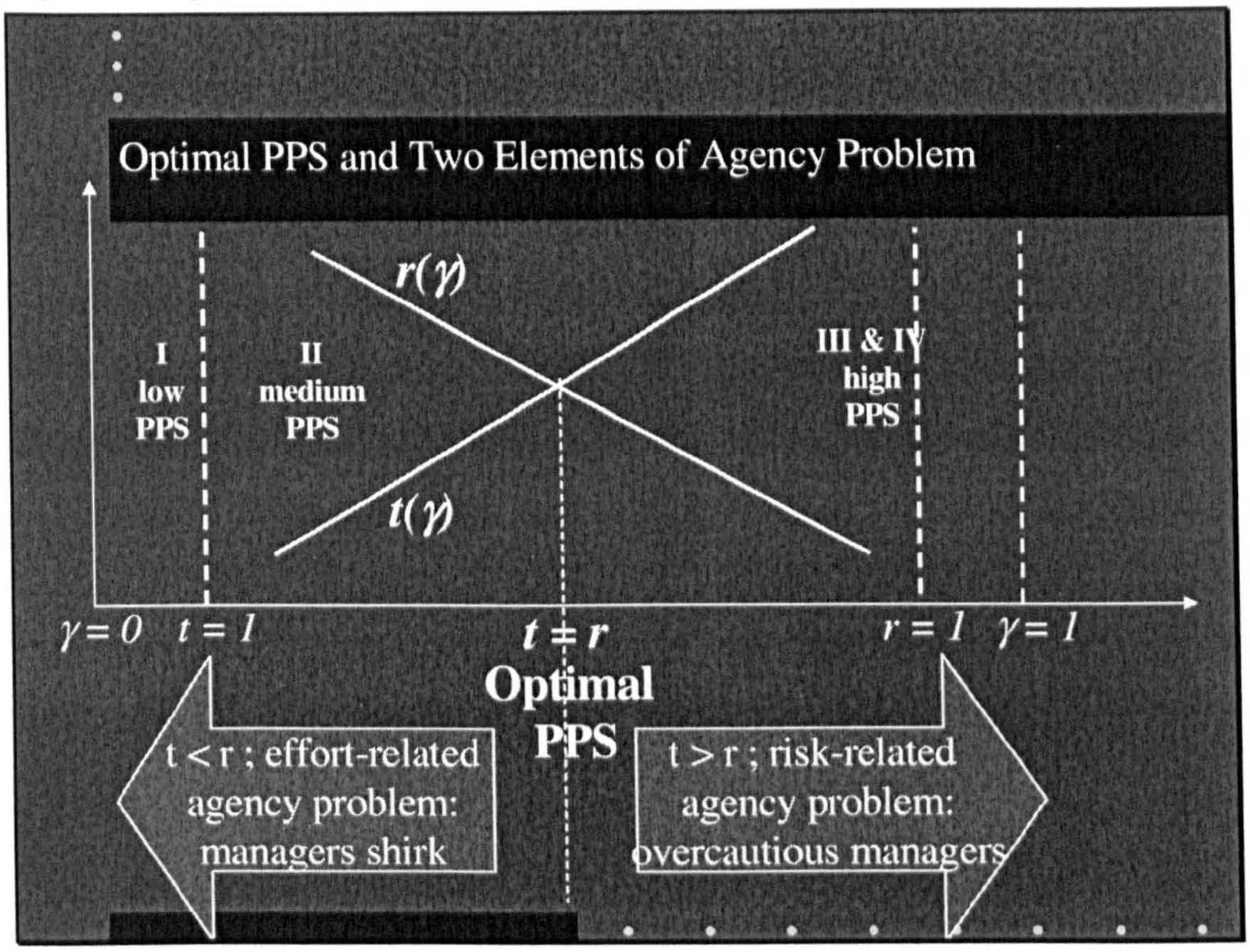
$$\frac{\pi R''}{R'} = \frac{aC''}{C'}, \text{ or } r = t, \tag{3.15}$$

is a useful approximation of equation (3.14).

Thus, the revised shareholders' optimisation problem (3.13) leads us to the optimal level of managerial participation in their firms' equity. Condition (3.14) applies to the optimal choice of equity based managerial pay. If the cost of managerial compensation is fairly insignificant for the company and need not be taken into consideration, condition (3.14) simplifies to (3.15). Equation (3.15) means that the optimal equity-based pay sets an equilibrium, where *firm production function is equally saturated with firm risk π and with labour factor, a.* This equilibrium implies that, under the optimal equity-based compensation system, shareholders exploit both sides of equity based incentives equally well: they encourage managers to take necessary risks for value creation and ensure the

appropriate level of job commitment (Figure 7). These two factors, if balanced appropriately, create a healthy environment within which managers may realise their potentials.

Figure 7. Optimal PPS and Two Elements of Agency Problem



The next important, and frequently discussed, issue in the literature is how the optimal level of managerial involvement in their firms' equity would depend on the level of managerial risk-aversion ρ. To address this issue, we differentiate equation (3.15) with respect to ρ. Implicit differentiation yields:

$$\frac{d\gamma_{opt}}{d\rho} = \frac{t' - rr'}{r'(t-1) - t'(1-r)} \tag{3.16}$$

We are interested in the sign of the right hand side of equation (3.16). If $\gamma = \gamma_{opt}$ we have: $t > 1$, $r > 1$, $r' > 0, t' > 0$, thus the denominator is positive. The nominator in (3.16), generally speaking, may be of either sign, which would imply that the optimal PPS might increase as well as decrease with the level of risk-aversion ρ.

An increase in managerial risk-aversion would reduce the efficiency of any equity-based compensation. High risk-aversion on the part of the managers weakens the incentive effect of managerial involvement and simultaneously exacerbates the divergence of managerial and shareholders' risk preferences. To counteract an increase in managerial risk-aversion efficiently, shareholders should again balance between these two elements of effort and risk. If the main threat to the firm comes from the possible lack of managerial job commitment, PPS should evidently rise with the level of managerial risk aversion to ensure the appropriate level of managerial effort. In the mathematical terms of equation (3.16) this case represents the positive nominator: $t' > rr'$. Indeed, in this case the production saturation with labour, t, is more sensitive and more important to be maintained than prodution saturation with risk r. However, if the main threat comes from managerial misjudgements in risk assessments, PPS should be negatively related to the level of managerial risk-aversion in order to maintain the appropriate level of firm risk. This case is reflected in the model by the negative nominator ($t' < rr'$) when production function is relatively sensitive to firm risk.

The revised version of hypothesis H2a, adapted for the top management agency problem, therefore, is given here:

H2b) In an effort-sensitive environment, optimal managerial PPS is an increasing function of the level of managerial risk-aversion. In an environment with higher rewards for efficient risk taking (risk-sensitive), optimal PPS is a decreasing function of the level of managerial risk-aversion.

It is argued here that traditional industries with rarely considered risky investment opportunities mainly constitute the effort-sensitive businesses. Good examples of the risk-sensitive business are joint ventures, IT and Telecom sectors. Ratios such as R&D/Sales may delineate these clusters of industries.

The next hypothesis on the properties of the optimal level of PPS is again derived from the balance equation (3.15). It is plausible to assume that the production saturation with managerial effort accumulates slower for high-ranked managers than for middle and low-ranked. This means that coefficient $t(a)$ should be lower for high-ranked managers than it is for low-ranked for any given effort level a. Balance equation (3.15) predicts higher

levels of optimal PPS if *t(a)* is low (for a formal proof see Appendix 1, Proposition 1). It yields to a logical conclusion that the optimal level of pay-performance sensitivity is higher for higher ranked managers. This seems to be a plausible result. Empirical studies approve that CEOs generally have higher level of PPS than other board members, see Buck et al (2004) with the UK data.

We may further search for external (environmental) factors affecting the relationship between contract design and firm performance in light of the model under study. Zeckhauser and Pound (1990) divide all industries into two groups according to their predominant information structure: *transparent* and *opaque*. According to their study, the prospects of such industries as Food Processing and Publishing are relatively easier to assess for outside shareholders and, thus, these industries are transparent. Electronics and Computer Software are, on the contrary, examples of opaque businesses that provide lower monitoring potentials for outside investors. Since monitoring and control tighten constrains over managerial actions, it is expected that negative effects of the departures from optimal contracting will be more evident in opaque environment with limited potentials for monitoring.

We assume that self-serving managers maximize their utility shaped by incentive contracts. If incentives fail to align managerial objectives with shareholders' preferences and contracts are not optimal, some negative consequences for firms' performance and value may develop. Monitoring in transparent environment may limit the scope of actions which damage firms' value and are induced by poorly designed incentive schemes. Transparent environment would be reflected in this model by an additional "monitoring" constrain in problem (3.8) which would model a degree to which managerial discretion is allowed. There is no such constrain in opaque environment, however, which makes deviations from optimal contracting more costly.

Following this line of reasoning, it is hypothesised here that empirical research is likely to detect more significant effect of contract design on ex-post firm performance in opaque environment with limited monitoring potentials.

H3a) Since monitoring and control tighten constrains over managerial actions, it is expected that the negative effects of the departures from optimal contracting will be more empirically evident in opaque environment with limited potentials for monitoring.

We already outlined the potential risk-related agency costs of excessive managerial conservatism in investment appraisals. Researchers argue (Milgrom and Roberts (1992), Guay (1999)) that this risk-related problem is likely to be especially acute for firms with substantial investment opportunities. The revised principal-agent model developed in this study supports this intuitive hypothesis. Indeed, an investment opportunity set with valuable growth opportunities would be captured in this model by relatively less curved efficient frontier $R(\pi)$ (Figure 3). The lower curvature of the efficient frontier means lower growth in production saturation with risk $r(\pi)$. If firm performance saturates with firm risk slower (i.e., in our terms, in a risk-sensitive environment), the model predicts lower level of optimal managerial PPS (Appendix 1, Proposition 2). This leads to the following hypothesis:

H3b) A negative risk-related effect of managerial equity-based pay on firm performance tends to be more severe in a risk-sensitive environment when firms have substantial investment (growth) opportunities. Thus, other things equal, equity-based pay is less effective and optimal PPS is lower in firms with valuable growth opportunities.

Thus, the revised principal-agent model developed in this thesis suggests that managerial equity-based pay may have at least two distinct and opposite effects on firm performance. The first effect is positive effort-related effect of managerial involvement. The second effect is negative, risk-related and is due to the risk-aversion on the part of poorly diversified managers. These two opposing effects create, or at least may help to explain hypothesised non-monotonic relationship between managerial ownership and firm performance. In addition, the model is versatile enough to support intuitive environmental effects on optimal contracting with hypothesis H3a on predominant information structure and investment-related hypothesis H3b.

3.4 Summary: the Agency Problem for Top Executives

This chapter highlights the fact that the usual principal-agent models discussed in the literature and used as a background for empirical studies mis-specify the agency problem, if used for top executives. A distinctive feature of top executives is that they are effectively in control of firm risk, at least to a greater extent than the shareholders. Existing principal-agent models keep firm risk independent of the agent's decisions, i.e. exogenous, which makes these models unsuitable for the case of top management.

This thesis acknowledges this fact and develops a principal-agent framework which captures the possible effects of managerial control of firm risk. The revised model views managerial action as a generalised investment decision, introducing the risk dimension into the managerial decision process.

The revised model shows that, as far as equity-based incentive schemes are concerned, managerial risk-aversion in investment appraisals is able to prevent the alignment of managerial interests with shareholders' objectives, and high pay-performance sensitivities, sometimes viewed as a panacea for agency conflict, do not always have a positive effect on firm performance. Risk-averse managers may manipulate firm risk to their own advantage. If their equity stakes become too large and risky, the value-creating priorities of the managers may be outweighed by value preservation, excessively cautious behaviour not correlated with shareholders' objectives. As a result, the model hypothesises a non-monotonic one-peak relationship between the pay-performance sensitivity of the managerial compensation package and firm value (Figure 6 and hypothesis H1b).

An equity-based executive compensation system affects the managerial perception of firm risk and the level of job commitment by tying managerial wealth to firm performance (Figure 2). If implemented cautiously, it exploits these two factors equally well: it encourages managers to take the necessary risks for value creation and ensures an appropriate level of job commitment. The optimal compensation system would balance these two factors, using available tools such as shares and options to align managerial efforts as much as possible with shareholders' preferences.

It is hypothesised here that the sign of the relationship between optimal PPS and managerial risk-aversion depends on the nature of the business (hypothesis H2b). Traditional industries with no apparent rewards for risky projects are argued to be effort-sensitive, and, therefore optimal PPS should rise with the level of managerial risk-aversion to ensure sufficient job commitment on the part of top management. On the other hand, new businesses, joint ventures and very competitive or high-tech industries may enjoy significant rewards for efficient risk-taking and penalties for inefficiency. Therefore, in this risk-sensitive environment, the optimal PPS decreases with managerial risk-aversion in order to lessen the managerial risk-burden.

The designed model helps to isolate positive effort-related and negative risk-related effects of managerial equity-based pay on firm performance. It supports intuitive environmental effects on optimal contracting with hypothesis H3a on predominant information structure and investment-related hypothesis H3b.

This chapter stresses that the compensation system that is optimal for a business clearly varies with industry, firm, and even individual manager. In theory, the optimum level of managerial involvement in their firms' stock depends on the managerial coefficient of risk aversion ρ, the managerial disutility of effort $C(a)$ and the investment opportunity set feasible for the firm's resources. Thus, the optimal compensation system reflects the individual characteristics of managers as well as external factors which the firm faces on the market (investment opportunities, macroeconomic conditions, industry growth and volatility, etc). Therefore, it becomes apparent that an efficient equity-based compensation system is not something static, fixed in time, since many of these factors are variable and change constantly. The level of managerial engagement in their firms' equity should reflect those changes when they occur, or even precede them if the changes have been forecasted in advance. The optimal managerial compensation system is a flexible one.

CHAPTER 4. The Cost Analysis of Equity-Based Pay

The previous chapter addressed the issue of the optimal structure of equity-based pay for top executives. The theory is developed to hypothesise on the optimal managerial involvement in a firm's equity, given business nature, the properties of the firms' investment opportunity set and managerial characteristics. However, to test the efficiency of remuneration packages adopted in real businesses, this theory must be strengthened by robust methodologies to assess costs and consequent benefits of managerial financial incentives. This chapter analyses the financial costs of equity-based managerial pay to the firms, using the "certainty-equivalent" framework developed by Lambert, Larcker and Verrecchia (1991) and Hall and Murphy (2000). The thesis extends the certainty-equivalent framework with the analysis of the effect on managerial risk seeking of shares and options, and with the developing of an index, measuring firms' financial costs of granting shares and options to top managers. This framework develops mainly around executives' options on the shares of their firms, but this approach may clearly be applied to other forms of market-based compensation: restricted stock in the USA and Long Term Incentive Plans in the UK. Firstly, however, we will discuss the role of share options in the modern compensation packages of top managers, reasons for their obvious popularity and ways options may help to ease the risk-related agency conflict, hypothesised and described in the previous chapter.

4.1 Risk-related Agency Conflict, Share Options and the Convexity of Pay

Chapter 3 of the thesis models the agency conflict within modern corporations as consisting of two elements: effort-related and risk-related conflict. The effort-related element is caused by the lack of managerial job commitment, whereas the risk-related side of agency conflict is related to risk-aversion on the part of the managers, which can cause the managers to ignore risk-increasing, positive net-present-value projects. To tackle these problems, linear profit-sharing incentive schemes are considered, effectively representing grants of firms' shares. It is shown that, under low-powered incentives, the effort-related agency costs prevail. High-powered incentive schemes based on shares, on the other hand, are hypothesised to exacerbate the risk-related element. Thus, the optimal managerial

compensation system finds and maintains a balance between these two extremes and minimises the sum of two agency costs.

As we can see, the essential drawback of share-based compensation is that, while easing the effort-related component of agency costs, it simultaneously increases the risk-related one. It is becoming clear that if we could find an equity derivative with less significant impact on managerial preferences towards firm risk, we would be able to design a better compensation system with lower residual agency costs.

Researches argue that share options may represent such a derivative, since they:

- Provide higher leverage than shares (the PPS of an option grant is generally higher than the PPS of a share holding of the same value)
- Increase in value as firm risk increases, easing managerial aversion to firm risk

Indeed, the pay-performance sensitivity of options with average market characteristics, if calculated as a sensitivity of the options' market value to the price of the underlying shares, is higher than the share holding PPS, given that both holdings are of the same value. That means that executive options provide a more effective and efficient solution to effort-related agency problems than shares.

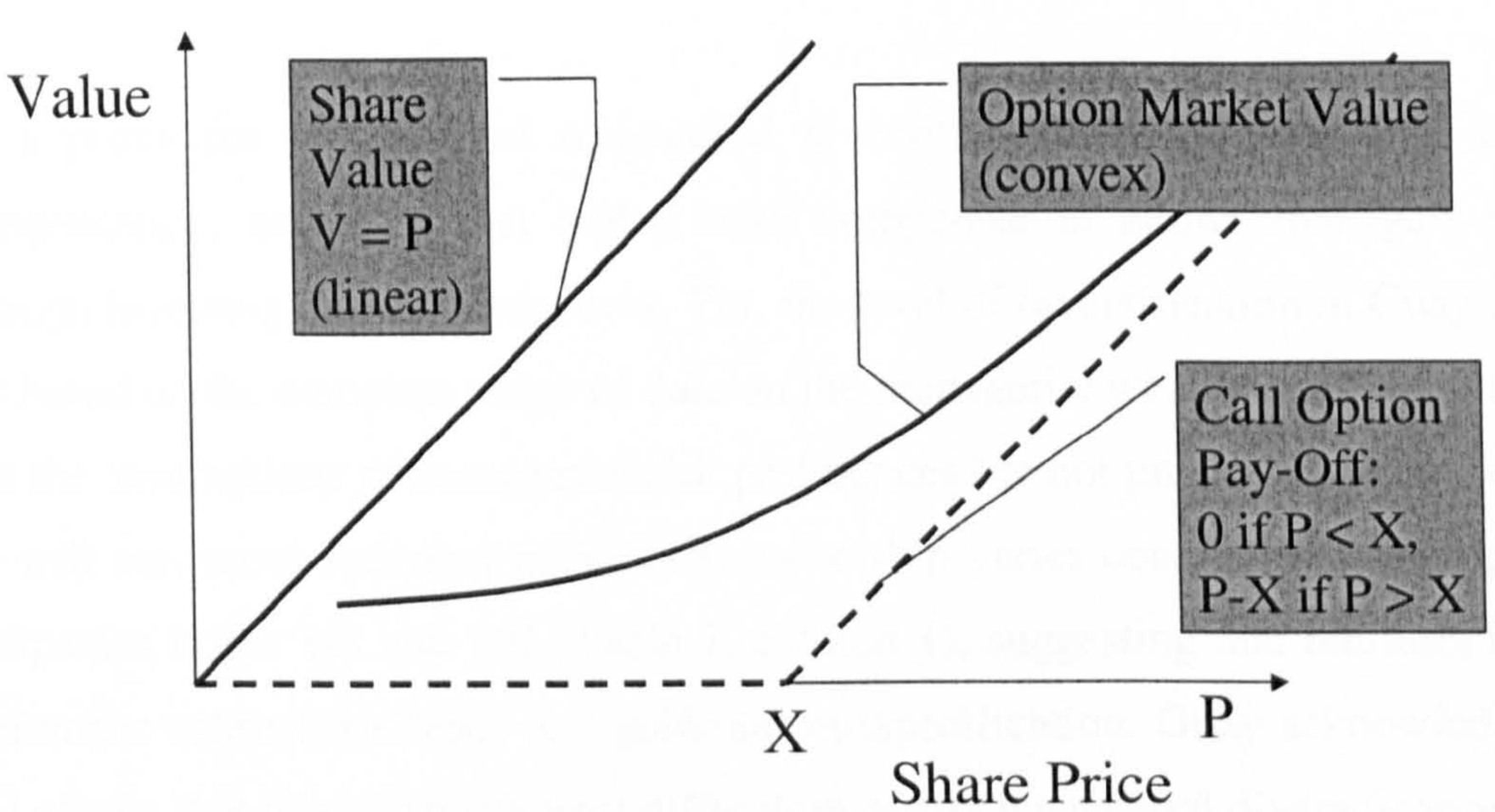
On the other hand, option market value is positively related to the volatility of the underlying shares, which is associated with the *convexity* of the option value with respect to share price (Figure 8). The convex option value implies that any uncertainty with respect to the price of underlying shares increases the average option pay-off and, therefore, may increase the expected wealth of the executives (see, for example, Hirshleifer and Suh (1992)). Thus, an executive option grant is expected to have a less costly risk-related agency problem component, than a grant of shares of the same market value.

It has to be mentioned here that, at least in theory, shares also have slight option-like convexity properties, especially shares of highly-levered firms. As Jensen and Meckling (1976) suggest, shares of a levered firm may be viewed as a call option to buy the firm at

an exercise price equal to the face value of debt. Therefore, the volatility of a firm's cash flows should positively affect the market value of the firm. However, in practice, shares' convexity is relatively insignificant and, further, in this research, shares will be treated as providing linear incentives. Guay (1999) investigates the convexity of the executive pay coming from options and shares and finds that the sensitivity of shares to equity risk is much smaller (several orders of magnitude lower) than that of options. Guay (1999) points out that, unless firms experience severe financial distress, the sensitivity of share price to equity risk coming from the firm debt is of "...little economic importance..."(p 66).

Thus, this fortunate convexity of share options is designed to fight an essential concavity of the managerial utility function. Although, as Lambert, Larcker and Verrecchia (1991) suggest, even in the presence of option-like incentives, managers are likely to remain risk-averse, it is clear that the degree of this risk-aversion may be softened by the positive relation between option value and firm risk. This results in less severe risk-related agency conflict and constitutes the main relative advantage of using share options instead of shares in equity-based managerial compensation packages.

Figure 8.The Convexity of Share Options' Value (where P is the share price and X is the exercise price)



4.2 The Certainty-Equivalent Approach

These potential benefits of convex, option-like pay schemes are well acknowledged both by researchers and practitioners. However, relevant quantitative researches are very rare and inconclusive. The study of Guay (1999) provides empirical support for the described theoretical derivations, finding a positive link between the firms' equity risk and the CEOs' pay convexity. Guay concludes that executive share options may provide managers with incentives to invest in risky projects and may be an especially attractive form of remuneration for firms with valuable investment opportunities, where potential loss from underinvestment in valuable risk-increasing projects is greatest.

However, the methodology employed by Guay is somewhat incomplete. It is clear that apart from the pay convexity, managerial perceptions towards firm risk are affected by the diversification level of managerial assets. Option tranches may add to pay convexity, yet simultaneously make that part of managerial wealth tied to their firms' performance more

valuable, making managers less diversified and more vulnerable to the firm risk. The case unaccounted for in Guay's analysis is that it may well be that the effect of increased aversion to firm risk due to change in diversification levels overcomes the positive effect of the convex pay. This would mean that high pay convexity is not necessarily associated with an increase in managerial risk seeking and the positive relationship between firm risk and pay convexity is just a consequence of a positive correlation between investment opportunities and equity risk.

As a proxy for the level of managerial diversification, Guay uses total annual cash compensation, assuming that higher cash compensation allows managers to diversify through investing outside their firms. Yet, the level of diversification in Guay's analysis is not based on the complete range of data on the managerial wealth structure, which implies that the assumptions of managerial risk preferences are not precise and may be biased. As we will see, cross-sectional managerial ownership varies considerably among the largest companies in the US and UK (Table 7, column 1), suggesting that omitting it from risk-preference estimations leads to significant misspecification. Guay acknowledges this fact and admits that it is generally very difficult to assess managerial diversification levels on a systematic basis, using all the available data on managerial holdings. Guay argues (1999, p 51) that "there is no clear method of determining the value of an employee stock option from the employee's perspective, as opposed to the firm's perspective".

The certainty-equivalent approach, adopted by this study, provides us with a methodology to assess managerial diversification levels on a systematic basis at least in relative terms. It leads to estimates of the value of executive stock options, robust enough to determine the cross-sectional differences and relative benefits/weaknesses of various compensation systems. This approach permits the assessment of the relative benefits of adopting option schemes with various exercise prices and option terms, comparing this with simple grants of firms' shares. As studies of Lambert, Larcker and Verrecchia (1991) and Hall and Murphy (2000) show, the certainty-equivalent framework may shed some light on almost every aspect of executive option design and associated executive behaviour:

- Choice of option exercise price
- Option vesting period, including the rationale for the short vesting period practice that is usually observed

- Observed tendencies on the part of executives to exercise options well before expiration
- The industry distribution of observed levels of executive pay, i.e. while the company cost of executive pay is significantly higher in more volatile industries, the risk-adjusted values are relatively stable across industries

Let us start the analysis with an example. Consider a company that grants to an executive a package of options that would otherwise (on the open market) be valued at £300,000. These grants are usually made with restrictions on their trading and hedging by the executives, in order to preserve the incentive effect and discourage executives from using shortsighted opportunistic behaviour, extracting immediate rent. Suppose that this executive already has much of his or her human capital tied up in the firm and also has existing savings in the form of company shares or earlier option tranches. Any risk aversion on the part of the executive in the presence of the enforced restrictions on trading and hedging will, therefore, cause the executive to discount in valuation the most recent package of options to an extent that it may have a certainty-equivalent (cash) value well below the £300,000 opportunity cost to the company. Thus, in terms of straight remuneration, a Pareto improvement appears to go begging, in the sense that the company could provide the executive with a cash payment that is preferred by the executive to the options it replaces, and that also costs the company less.

However, a closer look reveals that options' values are contingent on the company valuation, and options, at least in theory, provide executives with financial incentives to increase the company's performance. This increase in company performance may lead to an enhancement of company valuation that consequently outweighs any such shortfall in the valuation of the shares and options package, making equity-based pay a favourable technique for remunerating executives.

This chapter is organised as follows. Section 4.2.1 introduces the general approach to the certainty-equivalent evaluation as developed by Larcker and Verrecchia (1991) and Hall and Murphy (2000). Section 4.2.2 replicates and discusses the results of Hall and Murphy (2000) on pay-performance maximisation with option grants. Further analysis in this chapter is unique contribution of this research. Sections 4.2.3 presents further development

of the framework through the analysis of options' effects on managerial risk preferences with particular objective to facilitate managerial risk seeking. Sections 4.3 applies the certainty-equivalence approach to the total managerial wealth before and after the options are granted. Wealth-to-performance elasticity (WPE) and risk-reward trade-off (RR) indices are introduced herein as our proxies for risk-independent managerial incentives a and risk-related preferences π correspondingly (see section 2.8.4 of the literature review and general analysis of Chapter 3). The total wealth effects are more intuitive than the earlier option-package-only figures since they show the relative efficiency of option grants as a tool to mediate agency problems. Section 4.4 relates the above results to a mixed "second-best" contract of shares and options that would minimise the agency conflict and residual utility loss, maximising firm expected value. The main control tool with respect to which we will optimise executive option tranches is option exercise price.

Finally, section 4.5 develops Minimal Assumed Incentive Effect index (MAIE) of the firm's opportunity cost of option grants and reasons for an efficiency test for current option schemes adopted for top managers. If firms' financial performance is positively associated with the amount of resources firms are willing to spend on managerial option schemes and subsequent financial benefits overwhelm initial spending, option schemes do work. If benefits are inconclusive, current option schemes are malfunctioning and either misused by shareholders or abused by managers.

The proposed tests on the efficiency of equity-based pay adopted by real businesses, i.e. whether the company cost of executive pay is justified by subsequent firm performance, are carried out in Chapter 7 for FTSE 350 firms' CEOs in the 1998/99 financial year.

4.2.1. Executives' Valuations of Option Grants

Following Lambert, Larcker and Verrecchia (1991) and Hall and Murphy (2000), the value of a non-tradable option to an undiversified risk-averse executive is estimated as the amount of riskless cash compensation that the executive would exchange for the option. Consider an executive with initial wealth w = £2 million, split between riskless cash and company stock. Assume that the executive receives stock options3 with a Black-Scholes

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3 For a given share price, volatility etc., the actual number of options granted increases with the exercise

value of £300,000 with $T = 10$ years to maturity, volatility $\sigma = 0.3$ of underlying stock and under a risk-free market rate of $r = 0.055$ per annum. The Black-Scholes formula[4] gives the cost to the company of the grant of options as:

$$BS(P_0, X) = P_0 \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{y_1(P_0,X)} e^{-\frac{t^2}{2}} dt - Xe^{-rT} \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{y_2(P_0,X)} e^{-\frac{t^2}{2}} dt \qquad (4.1)$$

where, P_0 is a stock price at the moment of grant, X is an exercise price, and

$$y_1(P_0, X) = \frac{1}{\sigma\sqrt{T}}\left(\ln\left(\frac{P_0}{X}\right) + T\left(r + \frac{\sigma^2}{2}\right)\right),$$

$$y_2(P_0, X) = \frac{1}{\sigma\sqrt{T}}\left(\ln\left(\frac{P_0}{X}\right) + T\left(r - \frac{\sigma^2}{2}\right)\right).$$

The number of options granted, therefore, is given by $N(P_0, X) = \frac{300000}{BS(P_0, X)}$.

The Black-Scholes formula assumes risk-neutrality of the agent. While being applicable for the calculation of the company's cost of options, this formula is, therefore, not accurate in the assessment of an executive's valuation of the options. Due to risk aversion, one can hypothesise that undiversified executives would value options below their Black-Scholes values.

Following Hall and Murphy (2000), given an executive's initial wealth of w, the executive's wealth at time T can be modelled as:

$$W_T = W_T(P_0, P_T, k, X) = (1-k)w(1+r)^T + kw\frac{P_T}{P_0} + N(P_0, X)\max(0, P_T - X) \qquad (4.2)$$

where, P_T is the realised stock price at time T, and k is the fraction of initial wealth tied up in the company stock. (Three alternative cases are considered in a subsequent analysis, with $k = 10\%$, $k = 20\%$ and $k = 30\%$.)

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price.

[4] No dividends are considered, since, as in Hall and Murphy (2000), the incorporation of dividends does not change qualitative results. See Hull (1993) for formulae.

The award of riskless bonds V instead of options would leave the executive with wealth:

$$W_T^V = W_T^V(P_0, P_T, k, V) = \big((1-k)w + V\big)(1+r)^T + kw\frac{P_T}{P_0} \tag{4.3}$$

The "certainty equivalence" approach defines an executive's valuation $V = VS(P_0, k, X)$ of the option grant as the value of bonds that equates the executive's expected utilities of wealth from the two sources $U(W_T^V)$ and $U(W_T)$ under certain expectations of the distribution of future stock prices, $f(P_T)$:

$$\int U(W_T(P_0, P_T, k, X)) f(P_T) dP_T = \int U(W_T^V(P_0, P_T, k, VS)) f(P_T) dP_T \tag{4.4}$$

Further analysis assumes the utility function of the executive to be:

$$U(W) = \begin{cases} \dfrac{W^{1-\rho}}{1-\rho}, & \rho \neq 1 \\ \ln(W), & \rho = 1 \end{cases} \tag{4.5}$$

where, ρ is constant relative risk-aversion[5].

We use a lognormal distribution of stock prices to solve (4.4) for VS. This assumption of a lognormal distribution of stock prices is usual in theory and in practice. For instance, the derivation of Black-Scholes formula is implicitly based on this assumption, too. Hence, we model a distribution function $f(P_T) = f(P_T|P_0)$ of the stock price P_T at time T, given stock price P_0 at time zero as[6]:

$$f(P_T|P_0) = \frac{1}{\sigma P_T \sqrt{2\pi T}} \exp\left[-\frac{\left(\ln\frac{P_T}{P_0} - T\left((r+.035) - \frac{\sigma^2}{2} \right) \right)^2}{2\sigma^2 T} \right] \tag{4.6}$$

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[5] Recipients with ρ =2 and w=£2 million are indifferent between a 50% chance of an extra £300,000 and a 50% chance of zero extra, and £139,535 with certainty. For recipients with ρ =3, the certainty equivalent becomes £134,347.

[6] Following Fama and French, we assume a risk premium of 3.5%.

The numerical solution of equation (4.4) for *VS* gives the executive's certainty equivalent valuation of the option grant, which is typically lower than its Black-Scholes cost. It is worth noting that the executive's valuation may actually be higher than Black-Scholes cost when the recipient is sufficiently well diversified. As Hall and Murphy (2000, p8) note, this occurs owing to the executive's valuation of the option grant recognising the risk premium that is incorporated in the expected shareholder return to that particular stock[7] (something that is diversified away in the Black-Scholes valuation). Most executives are sufficiently exposed to risk through holding other equity instruments in the company that this marginal return is overwhelmed by the discounting effect of risk-aversion.

This executive valuation of option grants could be called a risk-adjusted valuation. Contrary to the Black-Scholes option pricing methodology, this utility-based approach is applicable to the case of an undiversified recipient and takes into account a recipient's risk aversion. The adjustments of the option prices for embedded risk support and often help to explain executives' claims those Black-Scholes methodologies overvalue their equity stakes.

Among all the parameters affecting option prices, in both the risk-neutral and risk-adjusted methodologies, parameters most easily controlled by the firm are the option term T and exercise price X. These two elements turn out to be very important properties of any executive option grant from the incentive point of view. For example, given the same fixed cost of £300,000, the firm could issue a certain number of options with exercise price well below the current share price, or, alternatively it could grant a greater number of cheaper options with exercise price above the share price. Although being of the same value for the market, these two grants are not valued equally by managers and may generate two very different incentive effects with respect to value creation and managerial attitude towards firm risk. Since equity-based pay is considered to be an important element of modern corporate governance, shareholders need to align the properties of the incentive packages with their own objectives, and in doing so, the option term and exercise price are valuable control tools.

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[7] This return, using the Capital Asset Pricing Model, is $r = r_f + \beta(r_m - r_f)$, where r_f is the risk free rate, r_m is the market rate of return, and β is the CAPM beta. Here the risk premium, $(r_m - r_f)$ is assumed to be 3.5%.

The next section shows that an effective management of option exercise price can ensure managerial PPS maximisation under fixed firm cost. On the other hand, failure to set up an appropriate exercise price will end up in an inefficient use of firm resources.

4.2.2. Option Exercise Price and PPS Maximisation

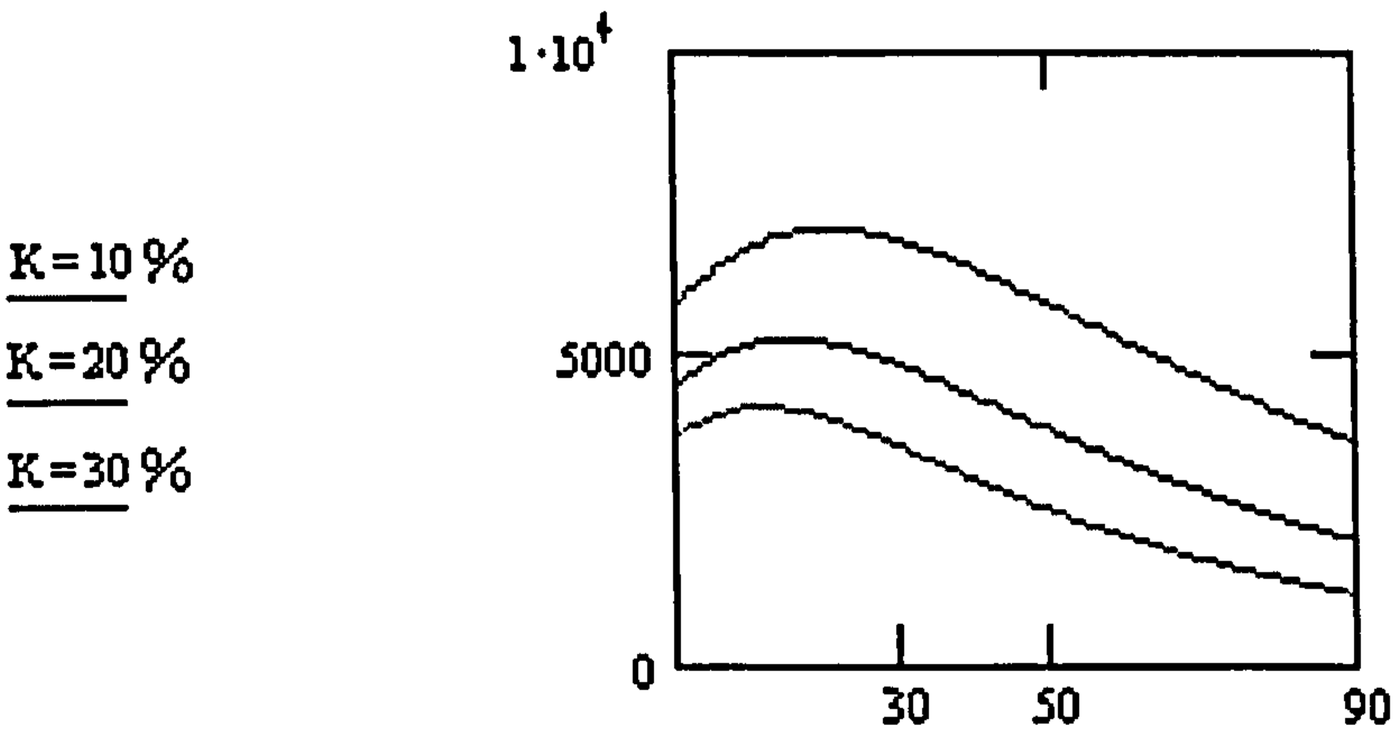
This section analyses the pay-performance sensitivity brought about by an option grant with a fixed Black-Scholes cost of £300,000. It will be shown that, since an executive's valuation of the grant differs from its risk-neutral market value, the quality of induced incentives depends considerably on the choice of option exercise price.

Hall and Murphy (2000) argue that the first derivative $\frac{\partial VS}{\partial P}$ represents the incentive to increase stock price provided by the option grant, since it shows the change in the certainty-equivalent value of the grant following a small change in stock price, i.e. the risk-adjusted pay-performance sensitivity of the grant. Implicit differentiation of equality (4.4) gives the pay-performance sensitivity of the option grant as:

$$\frac{\partial VS(P_0,k,X)}{\partial P} = \frac{\int_0^{\infty}\left(U(W_T(P_0,P_T,k,X)) - U(W_T^V(P_0,P_T,VS,k))\right)\frac{\partial f(P_T|P_0)}{\partial P_0}dP_T}{(1+r)^T\int_0^{\infty}U'(W_T^V(P_0,P_T,VS,k))f(P_T|P_0)dP_T} \qquad (4.7)$$

where, $U'(W) = W^{-\rho}$ is the first derivative of $U(W)$ with respect to the value W of the total package. Figure 9 depicts the pay-performance sensitivity $\frac{\partial VS(P_0,k,X)}{\partial P}$ of the option grant with a Black-Scholes value of £300,000 granted to undiversified risk-averse executives with $\rho = 4$ and variously $k = 10\%$, 20% and 30% of initial wealth in stock.

Figure 9. Change in the Executive Valuation of £300,000 of Options per £1 Change in Exercise Price



Exercise Price
(Assuming current share price = £30)

As can be seen, the option grant provides a lower incentive to less diversified executives. The exercise price that maximises pay-performance sensitivity is also lower for less diversified recipients. However, incentives are relatively stable around the maximum, which gives the firm the "freedom" to choose the exercise price within a certain range.

The exercise price for maximum pay-performance sensitivity is shown in Figure 9 for k = 10 % is £20.50 (68% of stock price); for k = 20% this is £15.40 (51% of stock price); and for k = 30%, £11.50 (38% of stock price). Figure 9 confirms that option grants may indeed provide higher leveraged incentives towards value creation than shares (here we consider grants of restricted shares with zero exercise price X = 0 and comparable limitations on trading and hedging). By setting an appropriate exercise price, company owners may ensure maximum managerial PPS for their money. Figure 9 shows that executive share options work particularly well when managers are not overloaded with shares (low k). If managers are poorly diversified, which makes them highly risk-averse (high k), options cannot provide significantly higher PPS than share holdings of the same value.

4.2.3 Option Exercise Price and Managerial Risk-Seeking

Among other firm-specific characteristics, the executive's value of the option grant $VS(P_0, k, X)$ depends on the expected volatility, σ, of the underlying shares. Therefore, apart from

incentives for value creation, PPS, option exercise price may be used as a tool to manipulate managerial attitudes towards firm risk, with the reasoning presented in section 4.1. So far, volatility of the underlying shares has been held at 0.3 in the analysis, which is close to the market average in the UK and US. Assuming that executives understand how their actions affect share prices, we can also assume that they have beliefs of the simultaneous effect of their actions on share price volatility. This section studies managerial preferences towards firm risk with one particular objective: how may an option grant be designed to increase managerial risk-seeking?

Executives' propensities to take risks could be measured as the share price increase that keeps executive wealth indifferent to a certain increase in stock volatility. The higher the minimum price increase that the executive would require for a certain increase in volatility, the more conservative the executive will be in strategic decisions. The impact of contemporary option grants on managerial risk seeking has been studied with mixed results. Agrawal and Mandelker (1987) find a positive relationship between executive option holdings and both increased return variance and increased company debt-equity ratio. These findings are echoed in DeFusco et al. (1990). On the other hand, both Lambert et al. (1991) and Carpenter (2000) argue that giving a manager more stock options can cause him or her to reduce volatility.

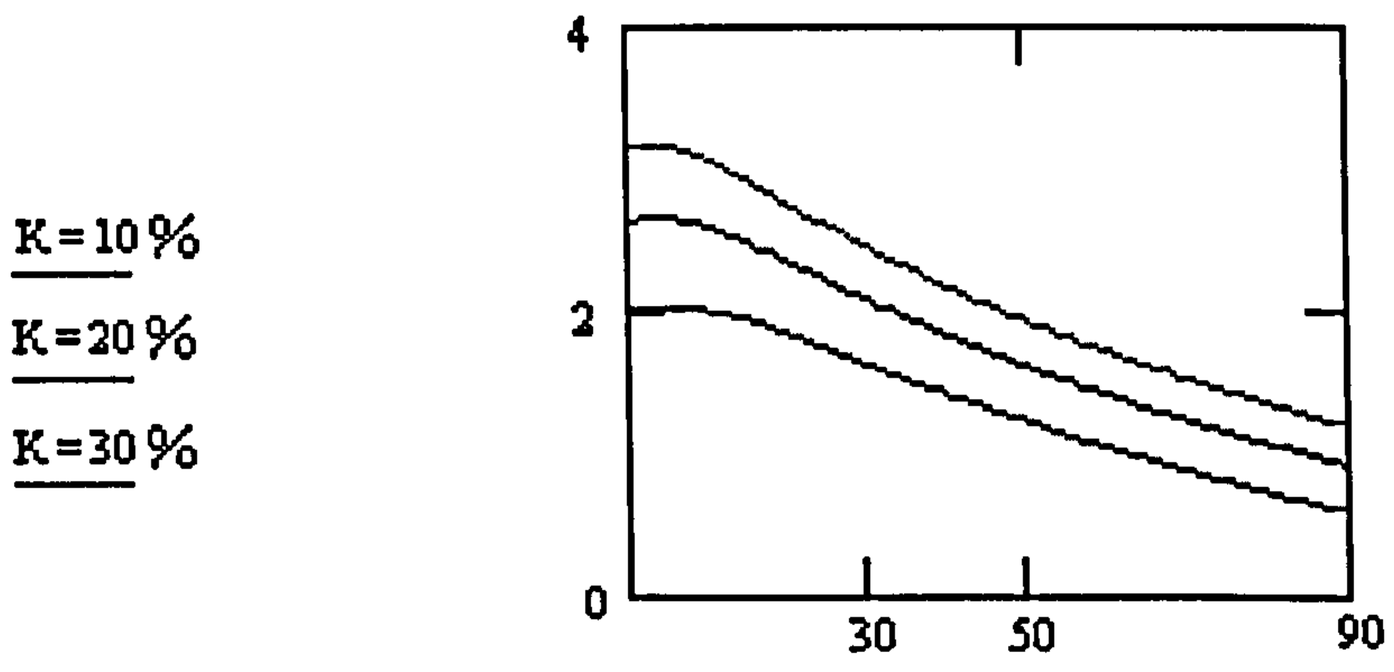
Implicit differentiation of (4.4) with respect to variance σ^2, combined with (4.7) gives the risk premium in terms of the share price appreciation that keeps the executive's option valuation (though not total wealth) indifferent to incremental changes in share price volatility:

$$\frac{\partial P}{\partial \sigma^2}\{VS(P_0,k,X,\sigma)=const\}=-\frac{\frac{\partial VS}{\partial \sigma^2}}{\frac{\partial VS}{\partial P}}=$$

$$=-\frac{\int_0^{\infty}\left(U(W_T^V(P_0,P_T,VS,k))-U(W_T(P_0,P_T,k,X))\right)\frac{\partial f(P_T,P_0)}{\partial \sigma^2}dP_T}{\int_0^{\infty}\left(U(W_T^V(P_0,P_T,VS,k))-U(W_T(P_0,P_T,k,X))\right)\frac{\partial f(P_T,P_0)}{\partial P_0}dP_T} \qquad (4.8)$$

Figure 10 plots the risk-reward trade-off imposed by the option granted to executives with $\rho = 4$ and 10%, 20% and 30% of initial wealth in stock. The vertical axis in Figure 10 indicates, for various exercise prices, the increase in share price necessary to keep executive's valuation of a tranche of options constant, given a prevailing share price of £30, when the variance increases by 0.01 (which amounts to a 5.4%, or 0.016 increase in volatility).

Figure 10. The risk-reward trade-off imposed by a £300,000 Option Grant (The increase in stock price that keeps the executive's value of the grant constant under a 0.01 increase in variance) (£)



Unsurprisingly, the reward for risk-taking demanded by executives (in the form of share price appreciation) is higher for less diversified executives. It is also not surprising that out-of-the-money options impose a less conservative attitude towards risk. Indeed, as was suggested in section 4.1, it is the convexity of the option-like pay-off that helps to fight the concavity of managerial utility and, thus, managerial aversion to firm risk. Figure 8 shows that the option market value is most convex when exercise price is lower than the share price, that is, when the options are out-of- the-money. The market value of in-the-money options becomes less curved, losing that risk-boosting potential.

Thus, Figure 10 confirms that the reward for risk demanded by executives, being a relatively stable function for deeply in-the-money options, can fall quite significantly if exercise price is set above stock price, and this finding does not depend on the

diversification level of recipients. In each case these profiles have a maximum at the intercept with the vertical axis, i.e., restricted stock. For at-the-money options (exercise price = current share price = £30) the risk-reward trade-off when k = 10% is £1.63, when k = 20% it is £2.1, and when k = 30% it is £2.47.

Comparing these results with the results of the previous section we clearly see that the firm's final choice of option exercise price would depend on the prevailing objectives that option tranches serve. If the firm's main intention is to increase managerial commitment and involvement by maximising managerial PPS, lower exercise price would be an optimum and at-the-money or in-the-money options are effective. If the firm suffers from the risk-related side of the agency conflict and would like to ensure that managers do not ignore risk-increasing, positive net-present-value projects, higher exercise prices and out-of-the-money options are more desirable.

The analysis that has been undertaken to this point provides some useful qualitative and quantitative properties of the executives' valuation of option grants and correspondent induced incentives. However, it is difficult to assess the comparative advantages and disadvantages of option grants as part of a pay package on the basis of these free-standing figures that relate solely to changes in option package valuation. Incentives created by option grants should be examined in the context of the properties of the total pay package. To tackle this question, I analyse the incentive aspects of executive pay packages with and without options (technically, just before and immediately after the option grant).

4.3 Total Wealth Perspective: The Impact of Option Grant on the Properties of the Total Pay Package

In this section, the same certainty-equivalence approach is applied to the total pay package before and after the options are granted. Hence, this section presents the impact of option grants on the executive's motivations. The total wealth effects are more intuitive than the earlier option-package-only figures since they show the relative efficiency of option grants as a tool to mediate agency problems.

The changes in the model are minimal. We still consider the same hypothetical risk-averse executive with initial wealth $w = £2\ million$, split between riskless cash and company

shares. Before the options are granted, all pay-performance sensitivity and conservatism in decision-making comes from the presence of company shares in the executive package. After option grant, as far as pay-performance is concerned, options just add their rewards for price appreciation to those of shares. However, the mixture of risk-reward trade-offs is not so straightforward. Options not only introduce a new trade-off, but also impact on the existing share-derived trade-off.

In order to calculate pay-performance sensitivity of the entire pay package, or, in other words, wealth-performance sensitivity (WPS), we have to amend equation (4.7) slightly. We are still within the same model, but now we consider the properties of the package as a whole. Following the idea of "certainty equivalence" and equation (4.4) we can define an executives' valuation of their total wealth V_{tot} as an amount of riskless bonds that would equate the expected utility of their total wealth. Equation (4.4) can be, therefore, rewritten as,

$$\int U(W_T(P_0, P_T, k, X)) f(P_T) dP_T = \int U((1+r)^T V_{tot}) f(P_T) dP_T$$

Bonds V_{tot} are granted at time 0 and their amount does not depend on share price P_T. It yields to a simplified equation

$$\int U(W_T(P_0, P_T, k, X)) f(P_T) dP_T = U((1+r)^T V_{tot}) \tag{4.9}$$

The WPS is the first derivative of the executives' valuation of their wealth V_{tot} with respect to share price and is an equivalent of equation (4.7)

$$\frac{\partial V_{tot}}{\partial P} = \frac{\int_0^{\infty} \left(U(W_T(P_0, P_T, k, X))\right) \frac{\partial f(P_T|P_0)}{\partial P_0} dP_T}{(1+r)^T U'((1+r)^T V_{tot})} \tag{4.10}$$

Figure 11 depicts a percentage increase in WPS (i.e. *ΔWPS/WPS*), after the option grant with a Black-Scholes value of £300,000. Because of the simple additive nature of pay-performance sensitivity, Figure 11 closely resembles Figure 9. Figure 11 emphasises, however, that the increase in the executive's incentive to create shareholder value in

relative terms depends heavily on the overall structure of the executive package prior to the grant, particularly on the proportion of executive wealth tied up in company stock. Thus, other things equal, less diversified executives would be less motivated by a grant of a fixed Black-Scholes value both because this grant is relatively less significant for them and because of the implied discounts of its value due to the heavy risk burden.

Figure 11. Increase in Wealth-Performance Sensitivity as a Result of the Option Grant (%)

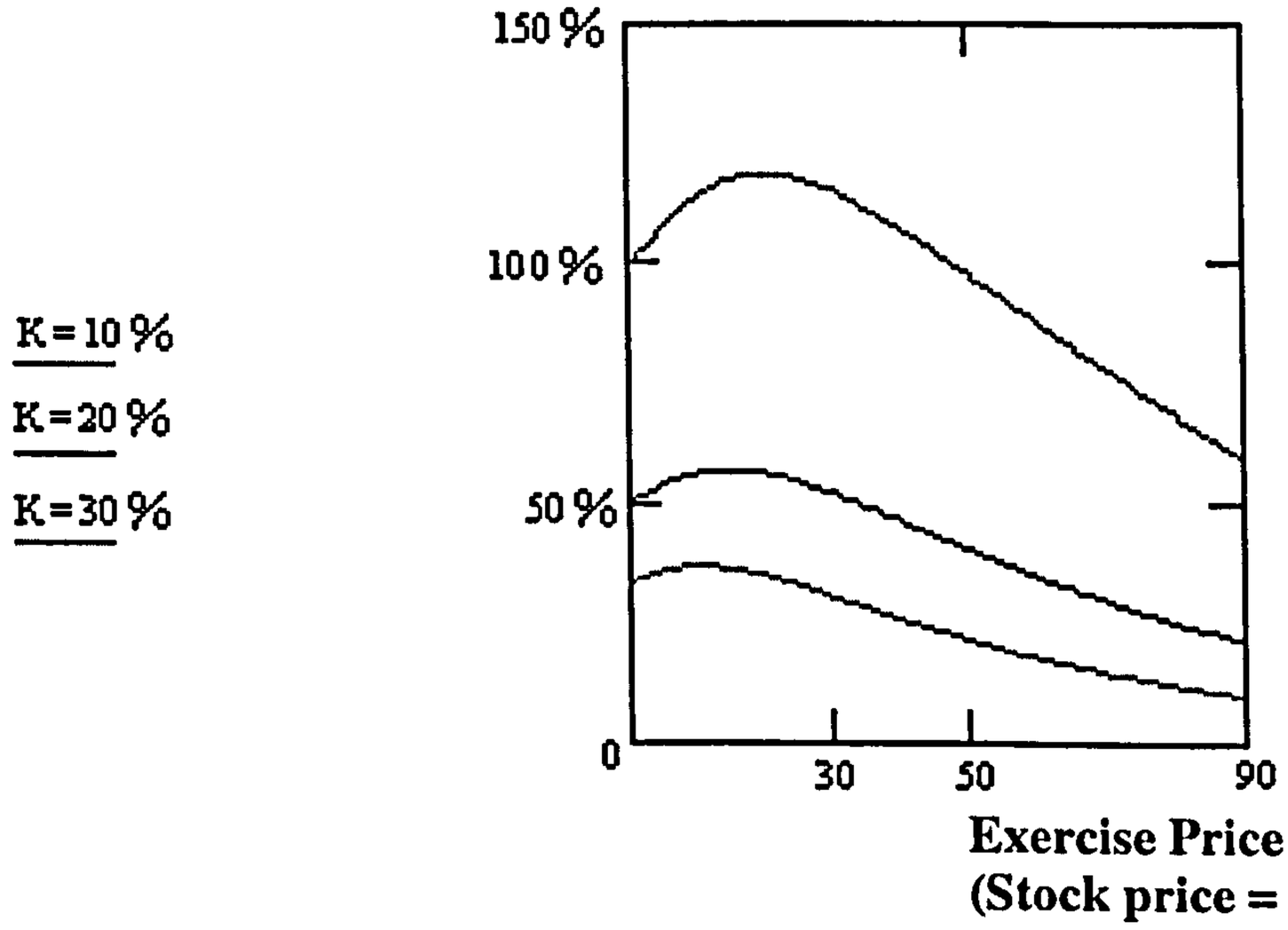


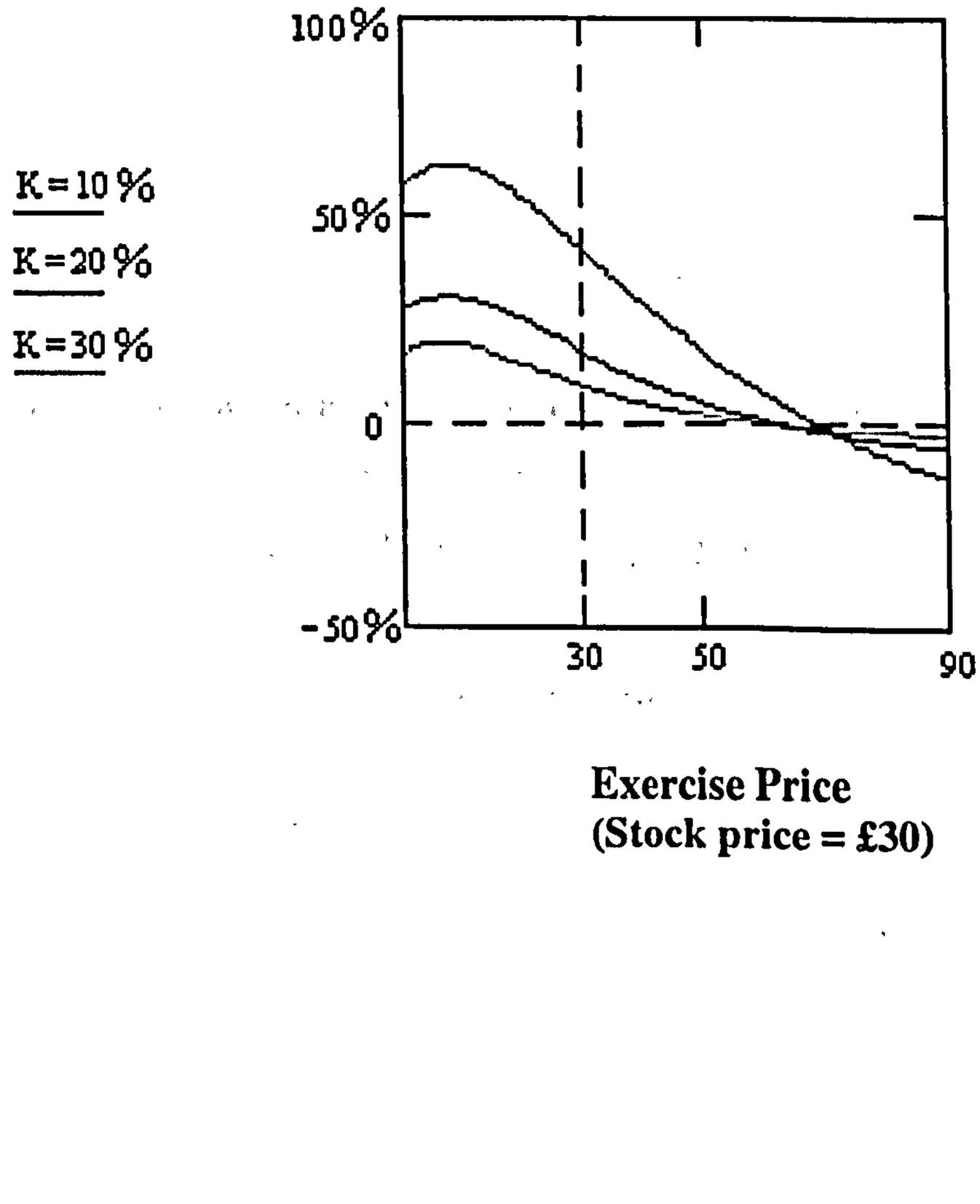
Figure 11 shows that option grants may indeed provide higher leveraged incentives towards value creation than shares. For the boost in WPS to be the highest, option exercise price should be below current share price in all our settings. Given a share price of £30, the exercise price at which these loci of the percentage change in the WPS as a consequence of the adoption of the option package is found to be at £20.70 (69% of stock price) when k = 10%, at £15.30 (51% of stock price) when k = 20%, and at £10.40 (35% of stock price) when k = 30%. It is worth noting that these values are very close to their correspondent values in Figure 9. Therefore, as far as options' pay-performance sensitivity is concerned, this "total wealth" perspective is consistent with Lambert, Larcker and Verrecchia (1991) and Hall and Murphy (2000) approach. On the other hand, as will be seen below in Figure 12, "total wealth" perspective allows obtaining a clearer picture of the effect of options on managerial risk preferences.

Apart from WPS and the level of managerial involvement, we are interested in managerial attitude toward firm risk and potential risk-related agency conflict. Let us define *executive conservatism in risk-taking, or, the risk-reward trade off,* RR_{tot}, as the price increase that keeps the executive's wealth valuation unchanged after a certain increase in stock volatility. In economic terms it is the rate of substitution of two factors and is represented by the implicit derivative

$$\frac{\partial P}{\partial \sigma^2}\{V_{tot} = const\} = -\frac{\frac{\partial V_{tot}}{\partial \sigma^2}}{\frac{\partial V_{tot}}{\partial P}} = -\frac{\int_0^{\infty}\left(U(W_T(P_0,P_T,k,X))\right)\frac{\partial f(P_T,P_0)}{\partial \sigma^2}dP_T}{\int_0^{\infty}\left(U(W_T(P_0,P_T,k,X))\right)\frac{\partial f(P_T,P_0)}{\partial P_0}dP_T} \qquad (4.11)$$

Figure 12 plots the impact on executive conservatism in risk-taking $\Delta RR_{tot}/RR_{tot}$ as a consequence of adopting the option package. This calculation uses the results of equation (4.11) computed just before and immediately after the option grant.

Figure 12. The Effect of an Option Grant on the Executive's Attitude to Risk (Resulting change in executive conservatism in risk-taking) (%)



From Figure 12, it can be seen that, given a share price, the exercise price at which the impact on the executive conservatism is highest, is £7.90 (26% of stock price) for k = 10%, £7.30 (24% of stock price) for k = 20%, and £6.70 (22% of stock price) for k = 30%. Furthermore, when the options in question are at-the-money (exercise price is equal to £30), the impact on the risk-reward trade off ($\Delta RR_{tot}/RR_{tot}$) is 42.5% when k = 10%, 17.7% when k = 20% and 8.8% when k = 30%.

The exercise price at which there is no shift of attitude towards firm risk ($\Delta RR_{tot}/RR_{tot}$ = 0) is £70 (233% of stock price) for k = 10%, £64 (213% of stock price) for k = 20% and £61 (203% of stock price) for k = 30%. All of these are, of course, well out-of-the-money.

Figure 12 shows in fact that *all* in-the-money and at-the-money options increase executive conservatism rather than decreasing it, as commonly believed. Moreover, because of the assumed managerial risk-aversion, in-the-money options may induce more conservative attitudes to risk than restricted stock (X = 0) with the same Black-Scholes value. As can be seen, for the option grant to reduce excessively cautious executive behaviour, exercise price should be much higher than the current stock price (about twice as high as stock price with our settings). Most *of modern executive option schemes have been granted close to-the-money.* Therefore, the model suggests that the majority of modern option schemes cannot tackle the cautious behaviour of top managers, and at their best, as suggested by this analysis, they induce a less severe risk burden than shares. This theoretical conclusion corresponds with the empirical finding of Wiseman, McNamara and Devers (2001) of a negative relationship between stock option grants and firm risk.

4.4 Second-Best Option Contracts: Choice of Exercise Price

In Chapter 3 we developed a refined model analysing equity-based managerial incentives from corporate governance perspective. A number of hypotheses and conclusions on optimal equity-based compensation level have been drawn. However, that analysis is complete only to a certain level of generalisation of the term "equity". Chapter 3 uses term "equity" as a broad generalisation of all possible financial derivatives based on the firm shares that could be used to remunerate executives. A more detailed view on each of the possible types of share-based derivatives requires further scrutiny.

Previous sections of Chapter 4 provide us with enough information on managerial option valuation to be able to take a closer view at the properties of optimal contracts that involve executive share options. Thus, combining the results of the general analysis of Chapter 3 and the intensive analysis of options in Chapter 4, we depart here from the broad "equity" term and consider a compensation system based on firm shares and share options. The objective being, as always, a "second-best" contract that would minimise the agency conflict and residual utility loss, maximising firm expected value. The main control tool with respect to which we will optimise executive option tranches is option exercise price.

4.4.1 Mixed Packages of Options and Shares and the Contract Curve

In order to use the results of the previous sections of Chapter 4, let us consider an executive with a risk-free wealth (in bonds or cash) of £1.6 million. Suppose that, in order to increase his/her job commitment and to ensure an appropriate attitude towards firm risk, his/her firm finds it optimal to grant him/her £700,000 in shares (with restrictions on selling and hedging), which would provide a balance of effort and risk incentives, $r = t$, minimising the sum of effort-related and risk-related agency conflicts. Figure 13 depicts this balance as equilibrium A. Restricted shares are treated here as options with zero exercise price, therefore I use notations $t(\gamma,0)$ and $r(\gamma,0)$ for managerial effort and risk lines under pure share contracts. The value γ of the optimum package of plain shares (equilibrium A) is assumed to be equal to £700,000.

One of the examples considered above in Chapter 4 is equivalent to the described package. Namely, the case of $w = £2$ mln and $k = 20\%$ in the previous section describes an executive with $(1-k)w = £1.6$ mln in bonds and $kw = £400,000$ in shares. After an additional £300,000-worth grant of restricted shares (X = 0), the effect of which is shown by Figures 11 and 12 (profiles $k = 20\%$), we obtain exactly our equilibrium package A. What is more important, Figures 11 and 12 help us capture the incentive effect of a mixed package of shares and options, which would appear had the firm granted options instead of additional shares.

Apart from equilibrium A, Figure 13 puts the results of Figures 11 and 12 together and shows other equilibria that emerge if mixed packages of options and shares are used to remunerate executives (curve ABC). I call this set of equilibria a "*contract curve*" since it represents the set of second-best mixed package contracts. The contract curve is parameterised by option exercise price *X*. The plan for the rest of the section 4.4 is to discuss how the contract curve ABC is constructed and what results with relation to mixed option and share packages it yields.

Suppose now that the firm wishes to use options along with shares to remunerate executives. Instead of granting £700,000 worth of restricted shares, the firm issues £300,000 of deep in-the-money options and grants the rest (£400,000) in the form of shares. As shown at Figures 11 and 12 (profiles $k = 20\%$), deep in-the-money options tie managerial wealth to firm performance closer than restricted stock, but simultaneously increase managerial conservatism in decision-making. Therefore, given the same market value, the package of deep in-the-money options mixed with shares provides stronger effort-related incentives and more conservative risk-related incentives than the initial grant of restricted shares. This evidently breaks the balance of incentives $r = t$ and implies that £700,000 is no longer the optimal package value from the incentive point of view. Since, with £700,000 worth of options and shares, the manager becomes over-involved and overcautious ($r < t$), to restore the equilibrium of incentives $r = t$ the firm should decrease the package value while keeping its general structure of 3/7 in options and 4/7 in shares.

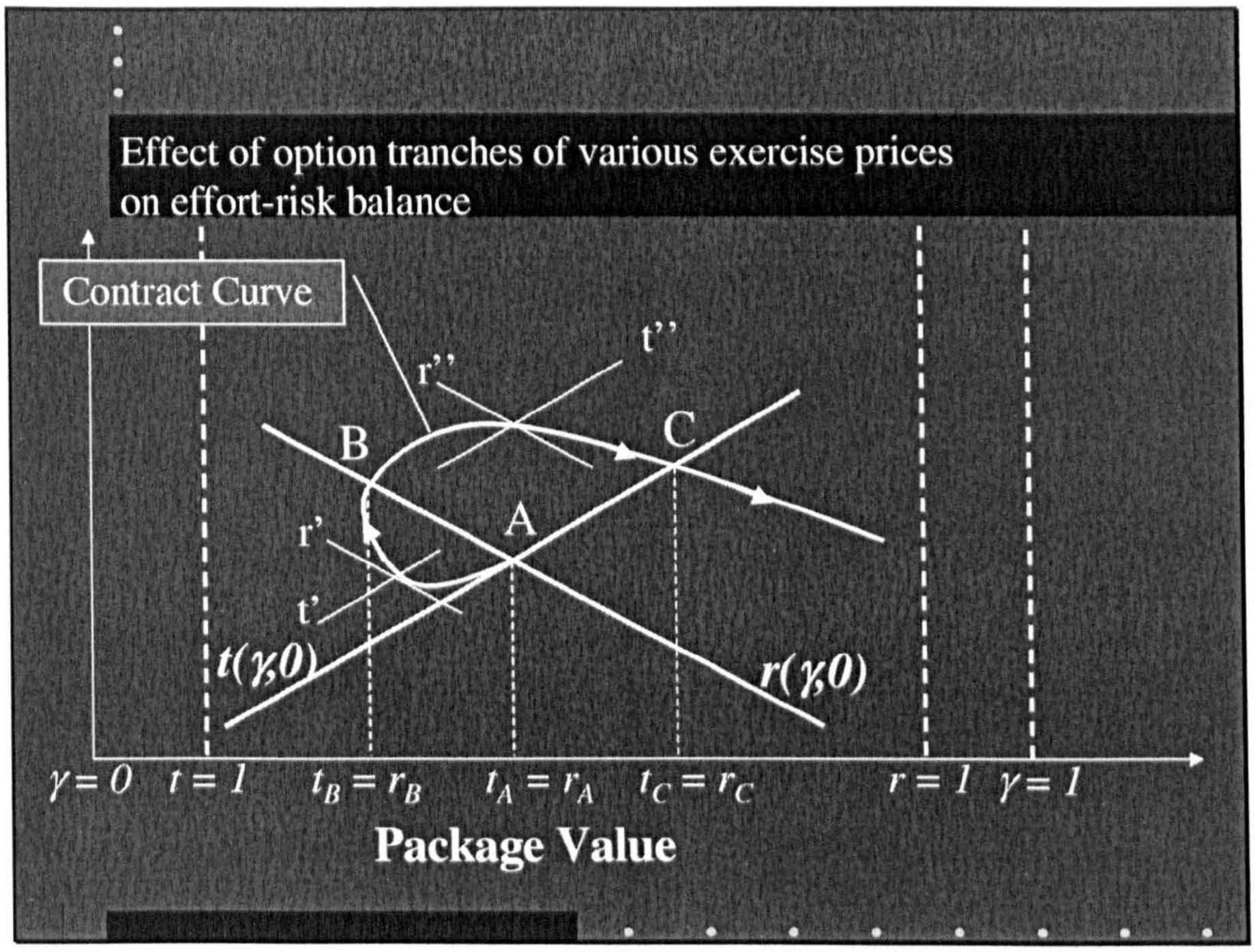
Indeed, Figures 11 and 12 imply that for low exercise prices (X less than 52% of stock price in our settings) the effort line $t(\gamma,X)$ lies above $t(\gamma,0)$ and the risk line $r(\gamma,X)$ lies below $r(\gamma,0)$. Therefore, intersection $r(\gamma,X) = t(\gamma,X)$ occurs prior to (to the left from) intersection $r(\gamma,0) = t(\gamma,0)$ and corresponding equilibria for $0\% < X < 52\%$ lie on the contract curve ABC between points A and B.

Next, let us consider the case of a mixed package of shares and options close to being at-the-money. Figures 11 and 12 indicate that options close-to-the-money provide a higher pay-performance sensitivity and a lower risk burden than restricted shares of the same market value. This is valid for options with exercise price ranging between $52\% < X < 112\%$ of the stock price in our settings. Thus, given the same market value, the package of

at-the-money options mixed with shares provides the manager with stronger effort-related and less conservative risk-related incentives than the initial grant of restricted shares. Correspondingly, the effort line $t(\gamma,X)$ lies above $t(\gamma,0)$ and the risk line $r(\gamma,X)$ lies above $r(\gamma,0)$, with the intersection $t(\gamma,X) = r(\gamma,X)$ occurring "above" the share-only equilibrium A at Figure 13, between points B and C.

Evidently, any executive pay contract providing equilibrium between B and C is preferable to the initial share-only contract with equilibrium *A*. Indeed, any equilibrium between B and C ensures higher level of managerial commitment, *t*, with higher level of managerial effort, *a*, and makes managers less oppose to firm risk (higher r) and more willing to seek out and pursue risky, but positive net-present-value contracts (higher π). Both these factors positively affect the firm's expected value, making at-the-money options a more effective way to fight the existing divergence of interests in modern corporations than shares.

Figure 13. Effect of option tranches of various exercise prices on effort-risk balance



Thus, in our settings, that I try to keep close to the actual median among the CEOs of FTSE 350 firms, option grants with exercise price ranging from 52% to 112% of the stock price are hypothesised to be more effective than shares in aligning managerial objectives with those of shareholders, provided that the shareholders are risk-neutral.

Equilibrium compensation packages of out-of-the-money options (X > 112%) and shares are represented by the part of the contract curve to the right of C. Out-of- the-money options have weaker effort-related incentives than shares (lower *t*), however, they induce a much lighter risk burden (higher *r*). Therefore, a mixed £700,000 worth package of shares and out-of-the-money options will be unbalanced ($t < r$). To increase its effectiveness, the firm should increase the package value, keeping its structure intact. This would restore the balance of incentives $t = r$, which, as we know from Chapter 3, is a necessary condition of optimal managerial compensation.

Table 4 summarises the reasoning behind Figure 13 and the concept of the contract curve, which represents mixed equilibrium contracts of shares and options of various exercise prices. Each point on the contract curve denotes a balance of incentives $t = r$, given a certain option exercise price. Now, which one of them should the firm choose? The answer to this question will give us the optimal exercise price to use with executive share options and is discussed in the next section.

Table 4. Summary on the effect of the option component of various exercise prices on effort and risk incentives (assuming risk-free executive's assets of £1.6 mln)

Package structure and equilibria on contract curve ABC	Corresponding exercise price X	Position of effort line $t(\gamma,X)$ and risk line $r(\gamma,X)$	Comparative analysis of effort and risk incentives	Package cost in effort-risk equilibrium
A: £700,000 worth of restricted shares; No options in the package	0	$t(\gamma,0)$ $r(\gamma,0)$		£700,000
A to B: 4/7 of package market value are shares, 3/7 are deep in-the-money options;	0% - 52% of stock price	$t(\gamma,X) > t(\gamma,0)$ $r(\gamma,X) < r(\gamma,0)$ effort line shifts upwards, risk line – downwards	Managers are more committed but less risk-seeking, than with package A of the same value	<£700,000
B to C: 4/7 of package market value are shares, 3/7 are options close-to-the-money	52% - 112% of stock price	$t(\gamma,X) > t(\gamma,0)$ $r(\gamma,X) > r(\gamma,0)$ effort and risk lines shift upwards	Managers are more committed and more risk-seeking, than with package A of the same value	< or > £700,000
Equilibria to the right from C: 4/7 of package market value are shares, 3/7 are out-of-the-money options	>112% of stock price	$t(\gamma,X) < t(\gamma,0)$ $r(\gamma,X) > r(\gamma,0)$ effort line shifts downwards, risk line shifts upwards	Managers are less committed and more risk-seeking, than with package A of the same value	>£700,000

4.4.2 Optimal Exercise Price

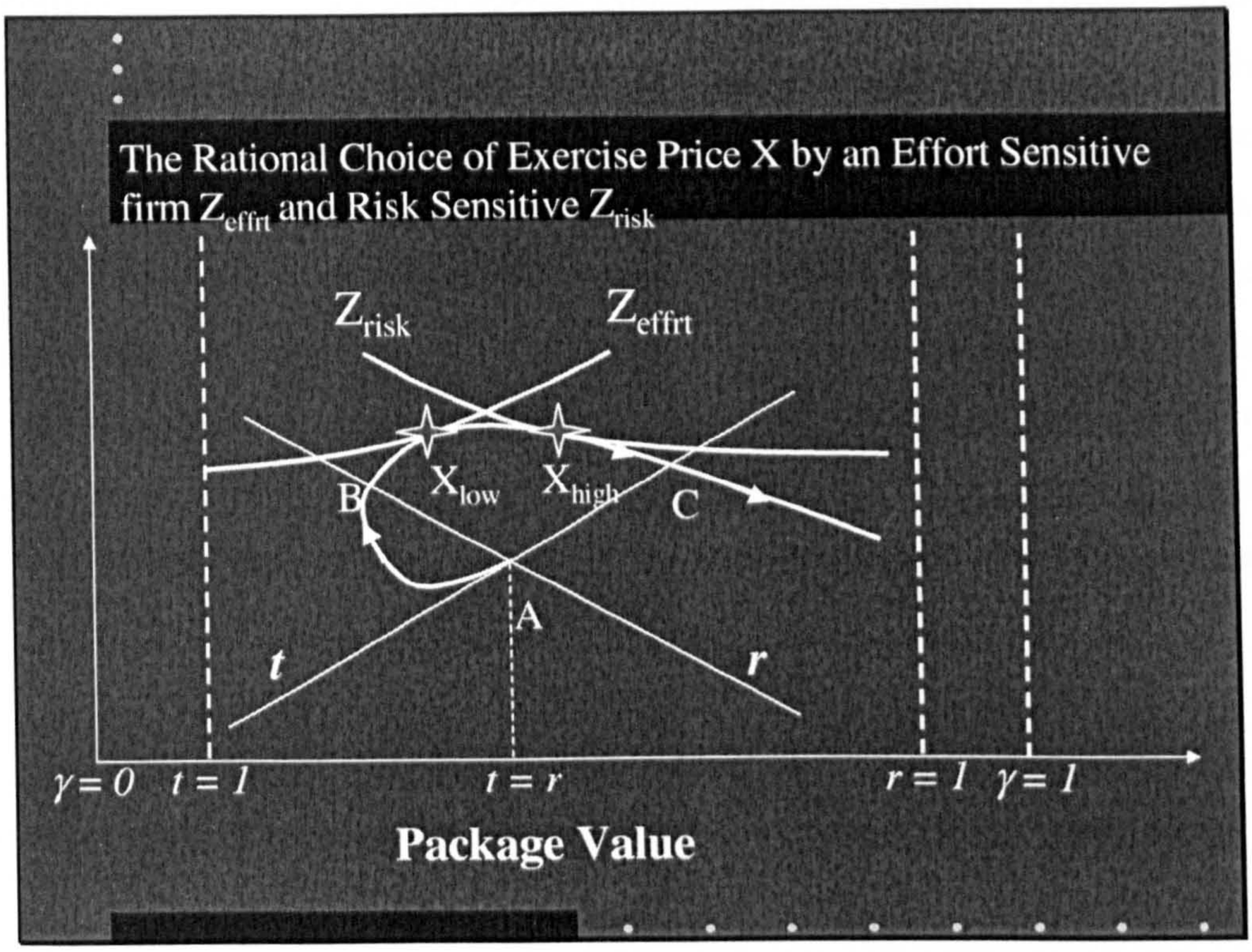
This section uses the framework developed in Chapters 3 and 4 to hypothesise on the best choice of exercise price of executive share options. As was pointed out before, the optimal

structure of executive pay depends on the individual characteristics of managers as well as external factors which the firm faces on the market (investment opportunities, macroeconomic conditions, industry growth and volatility, etc). Executive pay policy involves such issues as establishing standards for total compensation value, the desirable proportion of equity-based pay in total compensation, the breakdown of equity-based pay into shares, options etc, and, of course, setting up an appropriate option exercise price. As we saw in Chapter 3, the option exercise price's influence on the incentive side of option grants may be very significant for a typical executive. Thus, the exercise price of executive options should be viewed as an important corporate governance tool in shareholders' hands. This section focuses on the rational choice of option exercise price given some very general information on the firm's investment opportunity set.

As in the previous chapter, let us call a firm *risk-sensitive* if the main threat to the business comes from managerial misjudgements in risk assessments, and where the potential loss from underinvestment in valuable risk-increasing projects is greatest. Good examples of a risk-sensitive business would be very competitive, innovative, fast-developing or high-tech sectors where the risk assessment of prospective innovations, for example, is something very regular and almost routine and lies on the hands of top management. Today's innovations in these sectors very often determine tomorrow the company's profile and fate, thus, any risk misjudgement is very harmful and may be fatal for the firm.

Figure 14 plots the familiar executive contract curve ABC. Apart from these equilibrium loci it plots "utility curves" of two firms: risk-sensitive Z_{risk} and not so risk sensitive (or, effort-sensitive) Z_{effrt}. Since shareholders are risk-neutral, they are interested plainly in firm expected value Z, therefore, firms' "utility curves" represent here sets of effort-risk outcomes *(t, r)* which would produce the same firm value Z. It follows directly from our definition of risk-sensitive business that firms operating within an environment more sensitive to investment risk misjudgement have less steep, or even declining "utility" Z-lines.

Figure 14. The Rational Choice of Exercise Price by an Effort Sensitive Firm Z_{effrt} and Risk Sensitive Firm Z_{risk}



Indeed, if managers of a risk-sensitive firm become more cautious in investment appraisals (that is, if the managerial risk-line *r* shifts downwards) it seriously affects the firm's expected profitability. Supposedly, this negative effect may be off-set by an appropriate increase in managerial job commitment, resulting in the effort-line *t* shifting upwards. Therefore, the new equilibrium $t = r$ maintaining the initial level of firm value Z will appear to the left from the original one. More risk-sensitive environments will require a more significant increase in job commitment, shifting the new Z-neutral equilibrium further upwards on the *(t, r)* graph. Therefore, the more risk-sensitive a firm is, the more likely that the firm's "utility" Z-line has a negative slope. One can notice that the risk-line *r* coincides with the Z-line of the infinitely risk-sensitive firm in an environment where the level of managerial job commitment is irrelevant and the firm's profitability is defined solely on the basis of managerial risk preferences. Another limiting case is an infinitely effort-sensitive firm with managerial risk attitude having no effect on firm performance. In this case, firm's value depends on the level of managerial effort only and the Z-line coincides with the effort-line *t*.

Figure 14 shows that executive option contracts may be more effective than plain shares in softening a top management agency conflict, indeed. Figure 14 illustrates the intersections of the contract curve ABC with "utility" curves of constant firm value for a relatively more risk-sensitive firm Z_{risk} and a less risk-sensitive one Z_{effrt}. These intersections represent second-best option contracts in terms of exercise price. We can see that the firm's best choice of exercise price depends on the nature of the business, its environment and investment opportunity set. In particular, the analysis shows that firms that are more risk-sensitive should benefit from higher exercise prices. Simultaneously, the market value of optimal executive option contracts is hypothesised to be higher in a risk-sensitive than in an effort-sensitive environment in support of hypothesis (H3) of the general analysis in Chapter 3.

Overall, section 4.4 hypothesises that:

> H4) Options close-to-the-money may help provide a more effective solution to top management agency problems than executive share grants.

Consequently, more risk-sensitive businesses should benefit from executive option tranches with higher exercise prices.

4.5 Efficiency Test: The Minimum Assumed Incentive Effect of Option Grants

So far, the thesis has scrutinised various reasonings for and against equity-based executive compensation. The preliminary theoretical verdict is that, in the form of equity-based compensation, shareholders have in their hands a powerful mechanism to manipulate managerial interests and efforts. However, a common feature of all very powerful mechanisms is that it is very easy to misuse them, deliberately or not. Bebchuk et al. (2002) summarize the limits to forces which help to design and maintain contract efficiency in practice: managerial power, limitations to market efficiency and to the power of shareholders.

The first obvious threat comes from opportunistic executives holding too much power within their boards. *Managerial power concentration comes through concentrated*

managerial ownership and control over boards' composition and organisation. As discussed in section 2.1 of the literature review and summarized in Figure 2, managerial power may have a moderating effect on the quality of negotiated incentive contracts. Very powerful top managers (especially those combining CEO and Chairman roles) may be expected to influence the quality of incentive plans adopted for executives in favour of their own agendas. Baker et al. (1988) emphasise that compensation systems linking pay with performance may encourage executives to spend their time counterproductively on lobbying for easier performance hurdles and more generous rewards. Zajac and Westphal (1996) provide evidence that powerful CEOs tend to form "easy-to-govern" boards with passive members, which could limit boards' potentials to act in the best interests of shareholders. Thus, it is hypothesised here that powerful CEOs with control over board composition are less likely to be challenged by non-executives over the size and composition of their pay and more likely to deviate from optimal contracting.

Market forces which help aligning managerial and shareholders' objectives include market for corporate control (Marris (1964), Manne (1965)), market for managerial labour (Fama, 1980), and market for capital. While providing significant restrains on managerial behaviour through "outrage" and takeover threats in case of a serious managerial failure, these market forces, as argued by some authors, are not sensitive enough to ensure optimal compensation contracts (Bebchuk et al., 2002). Indeed, due to significant transaction costs of a takeover, a decline in firm's performance and associated shareholders' loss which could trigger a successful takeover is likely to be several orders of magnitude larger than a median cost of CEO compensation package (Easterbrook, 1984). "Outrage" constrains, which seem to be powerful enough to make the managers aware of the general market compensation trends and the outrage that their personal compensation may generate if it deviates from the trend (with potential damage to their reputation and career), are subject to a moderation effect of concentrated managerial power and managerial control over board dynamics (see discussion in section 2.1 and Figure 2).

If managerial power concentration limits firms' potentials to design and maintain contract efficiency, the adoption of corporate governance mechanisms which are designed to curb managerial discretion may have a complimentary effect on the quality of managerial remuneration. On these grounds, authors like David et al. (1998) view executive

compensation as an outcome of a power struggle between managers and shareholders. Concentrated managerial power, managerial control over board composition and lack of managerial accountability may lead to significant deviations from the optimal contracting and to inefficient incentive structure. Conversely, independent nomination and remuneration committees, activity of institutional investors on boards, presence of large outside shareholdings may all reduce managerial influence over their pay and increase the efficiency of negotiated contracts.

Apart from managerial power and limitations in market efficiency a number of other effects which could prevent the optimal contracting should be mentioned. For example, the impact of equity-based plans on managerial incentives is not often well understood by firms' remuneration committees and the shareholders. This is just because this practice is comparatively new, dynamic, and very fast developing.

Secondly, the efficiency of equity-based incentives declines with the complexity of compensation contracts. Conditions and hurdles targeted by incentive schemes should be very clear and vivid to managers on the receiving end. However, in many cases contemporary compensation packages involve too many performance targets and vesting conditions, an unnecessary complexity which disorientates managers. Some researchers argue that even simple unconditional options are not fully understood by top managers (see, for example, Hall (1998) p.3), weakening, therefore, the arguments of executive option proponents.

This reasoning calls for an efficiency test for current option schemes adopted for top managers. Therefore, this thesis develops and conducts this test for FTSE 350 firms' CEOs in the 1998/99 financial year. To test for the efficiency of executive option grants, I search for a relationship between the company's opportunity cost of option grants and subsequent financial performance. If firms' financial performance is positively associated with the amount of resources firms are willing to spend on managerial option schemes and subsequent financial benefits overwhelm initial spending, option schemes do work. If benefits are inconclusive, current option schemes are malfunctioning and either misused by shareholders or abused by managers.

As a proxy for firm performance, I use total shareholder return for the 1998/99 financial year. As the main explanatory variable of the opportunity cost of executive option grants I developed a Minimum Assumed Incentive Effect (MAIE) index, equal to:

(Black-Scholes Option Value – Risk-adjusted Value) / Annual Cash Pay

The Black-Scholes option value gives an open market option valuation, which the firm could have benefited from, selling the options to risk-neutral agents. The risk-adjusted valuation, developed in this Chapter, values options from the point of view of risk-averse executives' on the receiving end and is usually lower than B-S cost. Therefore, this new index MAIE gives the amount of resources that shareholders are apparently willing to give up, in this otherwise inefficient form of remuneration, in exchange for the boost in managerial incentives. How efficient is this practice? How efficient are adopted option tranches? For which firms do executive options appear to work better? Do any corporate governance variables influence the efficiency of adopted option grants? I will try to address all this questions in the empirical test for efficiency.

If managers do influence equity-based pay to their own advantage by lobbying for easier targets (e.g. lower exercise price) or unreasonably large option tranches, we should be able to trace the evidence of that by analysing incentives (WPE and RR indices) of the actual contracts. First, the impact the options have on managerial wealth-performance elasticity if weighted vs. the option opportunity cost for the firm constitutes cost-efficiency of the options. Second, equity holdings increase risk-return ratio RR. Excessive equity-holdings would result in high levels of RR index, which is hypothesised to be damaging for the firm (tested in Chapter 7) due to induced managerial conservatism in risk-taking. Therefore, if pay practice becomes management-serving rather than shareholder-serving, we are likely to see low cost-efficiency of the option schemes and excessive levels of induced risk RR. Here, the fifth hypothesis of the thesis is postulated in broad terms:

H5) Low concentration of managerial power and the adoption of corporate governance mechanisms which curb managerial discretion over their pay are associated with higher cost-efficiency of option grants and controlled levels of managerial conservatism.

4.6 Summary

This chapter is devoted to developing a robust methodology to analyse the efficiency of equity-based pay adopted by real businesses, i.e. whether the company cost of executive pay is justified by subsequent firm performance. The framework develops mainly around executive options on shares of their firms, but the approach adopted may be clearly applied to other forms of market-based compensation: restricted stock in the USA and Long Term Incentive Plans in UK.

To test various claims for and against hypothesised efficiency of option grants, first, a consistent methodology for risk-adjusted option valuation is developed. Wealth-to-performance elasticity (WPE) and risk-reward trade-off (RR) indices are introduced as our proxies for risk-independent managerial incentives a and risk-related preferences π correspondingly. Second, this methodology is used to draw some judgements on option price policy for a median FTSE 350 CEO. And third, the MAIE index is designed as a measure of the firm's opportunity cost of executive option grants. A significant correlation between the company cost of option-based remuneration and subsequent firm performance would be empirical evidence of option-based pay policy efficiency.

Theoretical analysis suggests so far that at-the-money options may induce closer alliance of managerial intentions and shareholders' objectives than grants of plain shares. The simulation results for a median FTSE350 CEO suggest that managers splitting 4/7 of their wealth in shares and 3/7 of the wealth in close-to-the-money options can have both more desirable risk preferences (higher π) and lower waste through risk-independent activities (higher level of a) than managers enjoying share package of the same total cost to the firm (Table 4). Option exercise price is playing an important part in this analysis (Figures 13, 14). It is suggested here that risk-sensitive businesses may find it optimal to set up higher option exercise prices to place a lighter risk burden on executives' shoulders.

There is a number of very convincing theoretical arguments that concentrated managerial power, managerial control over board composition and lack of managerial accountability may lead to significant deviations from the optimal contracting and to inefficient incentive

structure. Thus, this thesis proposes testing these theoretical predictions of an association of weak corporate governance with ineffective use of firm resources in executive pay. The proposed tests rely upon incentive indices WPE and RR and MAIE – our proxy for the firms' opportunity costs of options.

CHAPTER 5. Assessing Remuneration Quality: The Research Question and Working Hypotheses

This thesis addresses the issue of an effective and efficient executive pay system. Executive pay is viewed here as a corporate governance tool for easing the agency problems of a modern corporation.

Of central importance to the study is whether or not the practice of equity-based managerial incentives adopted in the largest UK based companies is justifiable and ultimately pays-off.

Contemporary executive compensation includes four basic components: a base salary, an annual bonus tied to accounting and other performance, stock options and long-term incentive plans, which can be viewed as grants of restricted stock with additional vesting conditions (usually on firm EPS and TSR). Extensive theoretical analysis of equity-based managerial pay carried out in Chapters 2 and 3 and the study of risk-related properties of executive options grants in Chapter 4 led to a number of hypotheses on the effectiveness and efficiency of equity-based incentives, summarised here.

First, it was demonstrated that the agency conflict between shareholders and executives within modern corporations consists of at least two elements: effort-related and risk-related conflict. The effort-related element is caused by the lack of managerial job commitment, whereas the risk-related side of agency conflict is related to risk-aversion on the part of the managers, which can cause the managers to ignore risk-increasing, positive net-present-value projects. It was shown that, under low-powered incentives, the effort-related agency costs dominate. High-powered equity-based incentive schemes, on the other hand, are hypothesised to exacerbate the risk-related element. The optimal managerial compensation system finds and maintains a balance between these two extremes and minimises the sum of two agency costs. Top management agency situation is complicated further with managerial discretion over firm risk, which makes potential effect of managerial risk aversion even more severe. Thus, it is hypothesised that

H1) Firm value is a non-monotonic, one peak function of managerial involvement in their firm's equity.

Second, it was argued that an increase in managerial risk-aversion would reduce the efficiency of any equity-based compensation. High risk-aversion on the part of the managers weakens the effort-increasing incentive effect of managerial involvement and simultaneously exacerbates the divergence of managerial and shareholders' risk preferences. Consequently, if the main threat to the firm comes from a possible lack of managerial job commitment and risk-unrelated waste of firm's resources, then the optimal level of executive equity holdings should evidently rise with managerial risk aversion to ensure the appropriate level of managerial effort. However, if the main threat comes from managerial misjudgements in risk assessments (which is likely to happen in firms with valuable investment opportunities Guay (1999)) the value of executive equity grants should be negatively related to the level of managerial risk-aversion to keep risk-related agency cost under control. Thus, it is hypothesised that

H2) In an effort-sensitive environment, optimal equity-based managerial pay is an increasing function of the level of managerial risk-aversion. In an environment with higher rewards for risk taking (risk-sensitivity), optimal managerial equity involvement is a decreasing function of the level of managerial risk-aversion.

The revised principal-agent model developed in this thesis suggests that managerial equity-based pay may have at least two distinct and opposite effects on firm performance. The first effect is positive effort-related effect of managerial involvement. The second effect is negative, risk-related and is due to the risk-aversion on the part of poorly diversified managers. These two opposing effects create, or at least may help to explain hypothesised non-monotonic relationship between managerial ownership and firm performance. In addition, the moral hazard model with endogenous firm risk supports intuitive hypotheses H3a and H3b. These two hypotheses link firm's penalties for departures from optimal contracts with firm's informational environment and the firm's investment opportunity set, which are, to a large extent, industry-specific factors.

It is well known that, in some companies, shareholders may find it very difficult and in some cases impossible to assess *a priori* the value of managerial strategic decisions, which makes it easier for the managers to shirk if they want to. Such companies with low monitoring potentials are called "opaque" (Zeckhauser and Pound (1990)). The opposite case is of a "transparent" business, with routine operations and strategies, and hence easy and efficient internal monitoring schemes. The analysis suggests that opaque industries have limited capabilities in protecting themselves against potential costs of the departures from optimal contracting, whereas industry risk-sensitivity is associated with more severe risk-related agency costs potentially arising from managerial equity-based pay.

H3a) Since monitoring and control tighten constrains over managerial actions, it is expected that the negative effects of the departures from optimal contracting will be empirically more evident in opaque environment with limited potentials for monitoring and the non-monotonic relationship between firm value and managerial equity therefore will be more pronounced.

H3b) The negative risk-related effect of managerial equity-based pay on firm performance tends to be more significant in a risk-sensitive environment, e.g. when firms have substantial investment (growth) opportunities. Thus, other things equal, equity-based pay is less effective and optimal PPS is lower in firms with valuable growth opportunities.

The costs of monitoring due to the business information structure are argued to rise with innovations, since frequent innovations are likely to make decisions made by top executives complex and nonroutine (Hoskisson and Turk, 1990). Expected rate of innovations is related to the industry average R&D intensity, with industry average R&D intensity thus playing an important role as a proxy for industry-specific cost of monitoring in H3a (see Zeckhauser and Pound, 1990).

Surely managers influence their firm's R&D expenditure, as they influence other measures of firm risk. However, industry average R&D intensity is believed to be an indicator of potential level of rewards for risk-taking in the industry (Guay, 1999), which is another external variable of interest in H3b. Therefore, the thesis suggests that the risk-sensitive

environment with high potential level of rewards for risk-taking creates higher monitoring costs situation through high R&D intensity and associated challenges of picking up worthy innovations. Hence, the interaction of H3a and H3b is assumed.

These general hypotheses are followed by a more detailed analysis of executive share option schemes. The effects of option grants with various exercise prices on both effort-related and risk-related agency problems were considered. The concavity of an option's pay-off was hypothesised to be a very useful feature to ease the risk-related element of the agency cost. More specifically, under the assumptions close to the median for FTSE 350 CEOs, shareholders may be expected to design more effective executive incentive schemes, mixing shares and at-the-money options, rather than using shares only. The risks of setting up too low or too high option exercise prices were explained both qualitatively and quantitatively using managerial wealth simulations. It is therefore hypothesised that

H4) Options close to being at-the-money may help to provide a more effective solution to top management agency problems than executive share grants. Specifically, option grants create more powerful incentives for value creation and lower distortion of managerial risk preferences than grants of shares of the same value. Option grants are associated with higher wealth-to-performance elasticity (WPE) and lower risk-reward trade-off (RR) indices.

Studying options further, we saw that the firm's best choice of exercise price depends on the nature of the business, its environment and investment opportunity set. In particular, the analysis showed that firms that are more risk-sensitive should benefit from higher exercise prices.

Finally, the adoption of a "certainty equivalent" framework allows us to assess managerial diversification levels on a systematic basis. This would lead to estimates of the value of executive stock options from the managerial perspective, as opposed to the firm's perspective. These estimates could help us determine the cross-sectional differences and relative benefits/weaknesses of various compensation system designs. Using publicly available data, it is now possible to assess the company's opportunity cost of executive stock options. Is this cost positively associated with the firm's financial performance? If

the answer is yes, it could suggest that, in the corporate governance of modern corporations, firms manage to use this very powerful, but tricky, tool of equity-based incentives appropriately. If, alternatively, the relation between the cost of incentives and firm performance is insignificant or even negative, the incentives are apparently not working because of their faulty design.

It is of vital importance that a corporate governance system be developed to help to allocate and use the firm's resources in an efficient way. The analysis argued that managerial power concentration and managerial control over board dynamics substantially increase managerial influence over incentive contracts and are likely to be associated with the inefficient use of the firms' resources and inefficient design of managerial pay in particular. Opportunistic managers, if powerful enough, have means to influence the tightness of all, both external and internal, corporate governance constraints (see Figure 2). The separation of CEO and Chairman roles and the adoption of independent nomination committee may lessen managerial influence over board dynamics and votes. This could provide a complimentary effect to the *efficiency* of other corporate governance mechanisms, in particular resulting in contract efficiency.

The thesis suggests that an efficient contract would, first, ensure an appropriate cost-efficiency of options in terms of an increase in managerial WPE per unit of options' costs. Second, an efficient contract would control for the level of managerial conservatism due to equity-holdings in managerial possession (including shares and options), which we estimate with the risk-reward (RR) index. Thus, it is hypothesised that

H5) The separation of CEO and Chairman roles and the adoption of independent nomination committee (e.g. not chaired by the CEO) will be associated with higher cost-efficiency of option grants (higher WPE per unit of costs) and controlled managerial conservatism (lower RR), reflecting the efficiency of adopted equity-based pay.

The possible complimentary effect of independent nomination committee on the quality of compensation design, hypothesised here, to my knowledge, has not yet been tested by empirical studies. Of course, logically, independent remuneration committee is as well

important to limit managerial influence on their pay and achieve better contract design. Empirical evidence of this can be found in Conyon (1997). This research, however, have limited means to test for the effect of remuneration committees on pay structure since only 1 out of 204 firms in the cross-section available for the study does not have remuneration committee (cross-sectional effect of the variations in remuneration committee size will be tested though).

Having established this list of working hypothesis, the thesis proceeds with an introduction to the research methodology adopted and to the data used to test these hypotheses empirically.

CHAPTER 6. The Research Methodology and Data

Methodology is a vital element of the philosophy of science and social science, and is focused on the specific ways – the methods – that can be used to try to understand our world better in general and to test our theories is particular. This chapter introduces and discusses the adopted research methodology, mostly as a system of methods and rules which help to assure the appropriate validity of the research findings. Although it may appear that the current research follows a purely deductive pattern of "theory – hypothesis – observation – confirmation/refutation", one can notice that the preliminary stages of the research contain elements of the alternative, inductive structure of "observation – pattern – theory".

Indeed, when Berle and Means (1932) first observed and reported the famous "separation of ownership from control" to point out that corporate managers often take actions that are not optimal from the shareholders' point of view, they made the first step from observation to pattern which later led to the development of agency theory. The current study uses an inductive approach in the sense of refining the principal-agent framework through the introduction of endogenous firm risk into the analysis (Chapter 3). The empirical observation that top executives are often able to influence firm risk should be properly reflected in principal-agent models, otherwise theoretical conclusions may seriously oversimplify reality.

Nowadays, agency theory continues to be improved both through deductive tests and inductive revisions. In the modern scientific society of post-positivism, it is widely believed that every theory is to some extent imprecise and subject to subsequent revision. However, even if absolute truth is unattainable we should try to approach it, close enough for the effective implementation of our theories in practice at least. This brings us to the important question of the research validity.

The validity of the research refers generally to the ability of the research to reach a valid conclusion. The quality of the employed research methodology is of central importance here. In every study, there is a threat that logical imperfections and/or measurement errors lead to biased conclusions. Moreover, during the course of the research slight

imperfections and errors, probably not significant if considered separately, are likely to accumulate and threaten research validity. Ideally, choosing an appropriate research methodology for each part of the research process should minimise the threat to research validity. Here four types of threat to the research validity are discussed with the research methodology adopted by this study.

6.1 Four Threats to Research Validity and How This Study Copes with Them

In broad terms, this study is about the relationship between managerial financial incentives and firm performance. All six hypotheses derived from the previous theoretical chapters suggest a certain link, or, correlation between the structure of managerial financial incentives and firm performance. Therefore, empirical tests should address the question: is there any relationship between our measurements of financial incentives and our measurements of firm financial performance?

The credibility with which we come to our conclusion of a certain relationship (whatever it might be – positive, negative, or no relation at all) in the collected data is called *conclusion validity* (Trochim, W. (2000)). The current study employs statistical analysis to ensure an appropriate level of conclusion validity. In quantitative research, such as the current study, the main threat to conclusion validity comes from violations of assumptions regarding the procedures used to conduct the analysis. Specifically, assumptions of statistical tests may be violated.

Statistical analysis helps to construct and test an explicit model of the relationship in question. Construction of an explicit model, a fundamental sign of any quantitative study, forces the researcher to think clearly about, and reflect in the analysis, all the important interrelationships involved in a problem. It is also important that individual relationships are tested and confirmed in some way or another. Statistics provides researchers with reasonably flexible tools that help to break down a complex relationship into logical subgroups of individual effects and then test their significance separately. In addition, a quantitative study on a large scale is likely to be less biased and have wider applications, compared with case studies, for example. We will come back to this issue later when discussing the external validity of the research.

The choice of the most appropriate statistical model is a difficult issue and, by most statisticians, is described as a sequence of intuitive judgements under chosen theoretical guidelines and with some assistance from statistical tests. These intuitive judgements mostly concern model specification and design. All the explicit models designed in this study are from a class of single-equation multiple regression models. In this class of models, the relationship under study is described by a single function of several explanatory variables. Once the model is designed and the shape of the function found, one can predict the individual effect of all the variables included in the analysis on the dependent variable under study.

In this study, the dependent variable is firm performance, and the main explanatory variable is managerial financial incentives. It is important to note that managerial financial incentives may be represented by a number of different variables: proportion of managerial wealth tied to the firm, managerial wealth-performance sensitivity, sensitivity of managerial wealth to firm risk, etc. Thus, the relationship function under study may be of many variables.

Other explanatory variables may include various measures of corporate governance quality, and so-called control variables reflecting the fixed effects of firm size, industry and so on.

The estimation techniques of single-equation, multiple regression models require that certain assumptions be made about both the data and the model. The most important example of these assumptions is that of homoscedasticity and of no correlation between explanatory variables and the error term. If this assumption is not satisfied, the relationship estimates are likely to be inefficient, biased and inconsistent. There are a number of ways to minimise this possible threat to the conclusion validity of the research, with the help of statistical analysis:

- Maintain good statistical power: 0.05 or 0.10 significance level in t- and F-tests.
- Use reliable and representative data: as the current study is about the equity-based pay of top managers of large publicly traded UK based companies, the data is collected on all non-financial FTSE 350 firms which use option grants to remunerate top

executives. (Some financial institutions as pension funds and insurance companies, specialising in portfolio investment are excluded because their performance is dependent to a large extent on the performance of other firms already in the sample. Banks and the like, however, remain in the sample.)

- Ensure that there are no violations in analysis procedures. (Potential problems such as mis-specification and heteroscedasticity are relevant to our study and will be addressed accordingly.)

In short, to minimise the threats to conclusion validity in quantitative research, one should identify and use a reliable source of representative data, build the relationship model which is most appropriate and ensure no violations during its statistical tests. All these precautions are taken in the subsequent statistical analysis.

The second area of potential threat to the research validity involves the causality that lies behind uncovered relationships. Providing a certain form of the relationship is found, the next step is to identify, or, at least try to estimate the degree and direction of causality. The credibility with which we identify the causality mechanism is called the *internal validity* of the research. Evidently, the direction of causality, and hence internal validity, can hardly be identified by statistical techniques. Statistical tools are helpless here in the case of cross-sectional data or data collected for two points in time, as in this research. Even more elaborate statistical techniques such as Granger causality tests, available for time-series data, are not always efficient in identifying the real causes and effects, e.g. because of the possibility of simultaneous or lagged cyclical movements in the "dependent" and "independent" variables. Thus, to argue for the internal validity of the research, one should use other lines of reasoning, mostly theoretical.

This study argues that managerial compensation and firm performance both affect each other. Pay-performance incentive effects are part of the direct effect of governance on performance, while performance – pay effects involve feedback loops that arise through performance-triggered changes in managerial equity value and through performance, itself influencing governance structures. As was discussed in the introductory chapter, there are many reasons to believe that both pay-performance incentive effects and feedback co-exist and are relevant to our study.

This research mainly addresses the straightforward incentive effect of pay on performance. In order to isolate it from the reverse relationship, a short-time lag of one year is introduced on firm performance in tests on the association between managerial ownership and firm performance. It is argued here that this lag of one year is sufficient for incentives to begin to work. On the other hand, it is unlikely during one year that the slower-reacting governance structures change significantly, upsetting the direct relationship. Thus, the appropriate research design helps to isolate the relationship in question (i.e. the direct pay to performance relationship), minimising this threat to internal validity.

The next problem area in any quantitative research is the validity of all conducted measurements: do we actually observe and measure what we want to observe and measure? In this study, the problem relates to the measurements of our dependent variable (firm performance), independent variable (managerial ownership structure) and control variables (mostly, corporate governance). To ensure robust results, this thesis therefore uses two alternative performance measures: the ratio of the firm's market value to the replacement cost of its physical assets and firm's annual TSR (total shareholder return). Both indexes are widely used for this purpose both by researchers and practitioners. As a measure of managerial ownership, this study uses publicly available information disclosed in annual reports where top managers of the UK based companies are obliged to provide detailed information on their holdings of the firm's equity. Obviously, not all information on the possible equity holdings held privately by the managers can be acquired in this way. Managers may possess significant stakes in other firms that they don't have a contractual relationship with, and these other firms may in turn have stakes in the firm under study; this type of private managerial shareholdings is unaccounted for in this study. Undoubtedly, managerial holdings of other firms' equity may interfere with the incentives of equity-based pay, reducing their statistical significance. Acknowledging this potential drawback, it should be stressed here that this thesis nevertheless assembles the most complete set of data on cross-sectional managerial pay among contemporary UK studies. As suggested by Anderson and Lee (1997), data collected from annual reports are superior to other data sources, although it is time consuming to acquire and organise. Together with suggested refinements to the theory, this constitutes an important contribution of the current research.

The final issue concerning research validity to be stressed here, which also affects and reflects the choice of research methodology, relates to its generalisability, i.e. the relevance of its findings to other contexts. Usually, the broader the sample used in the statistical analysis, the wider the applications of the results that may be expected. Nevertheless, every study has application limits. This study is conducted in the context of large publicly traded companies in an environment of a liquid and responsive share market with predominantly dispersed shareholders, typical of Anglo-American corporate governance. These assumptions hold for most of the large publicly owned UK and US companies. However, differences in business legislation, prevailing forms of corporate governance and issues of tax treatment of managerial shares and options may limit the applicability of the results of this study to German and Japanese firms, for example. These limitations may be especially significant for option analysis. This type of research validity is referred to as *external validity*.

The main threats to external validity often come from sample construction. If our study uses a sample of a broader population, can the results we obtain for the sample be generalised to the whole population? Is the sample representative? This brings us to the issue of the data and sampling methodology that is used in this study. The next section describes the construction of the data for this research in detail.

6.2 The Data

This research is based on 1997/98 and some of the 1998/99 financial year data on companies in the FTSE350. The information on managerial pay was collected mostly from the remuneration committee reports within annual financial reports, whereas firms' financial data was obtained both from the annual reports plus DATASTREAM. The advantage of using firms' financial reports for research on top management is that they include remuneration committee reports that reveal the structure of managerial pay in detail: holdings of ordinary shares, annual cash pay, any performance-contingent incentive plans in use, further details on managerial share options (option term, exercise price) etc. The disadvantage of using annual reports is that it is time-consuming to put this data into

an organised electronic version for subsequent analysis. This disadvantage is particularly relevant for options and LTIPs.

An ideal data for this research would have included information on every executive director on the board as preferences of all directors potentially shape decisions of the top management team. However, as mentioned above, detailed structure of managerial pay is time consuming and/or costly to obtain. Thus, for the proposed pay-performance tests I decided to focus on CEOs only, since CEOs are the most influential directors on the board. Among all directors, CEOs' personal interests and financial preferences can be expected to have the most significant impact on the firms' strategies. Given certain time constrains, it is more efficient to focus on CEO only and collect the data on as many firms as possible than analyse executive teams of a few companies.

Since the main contribution of the research is expected to be in the area of efficient option contracts, I limit the sample to companies that actively use option grants to remunerate CEOs. Out of initial 350 companies, 46 pension funds and insurance companies, specialising in portfolio investment, were excluded. Performance of the funds which are using their capital mainly to invest in shares of other firms in the sample could not be considered as independent and would bias our statistical inference. Besides, these companies are "outliers" in a sense that they have few employees and usually have no executives on boards. Banks and other providers of finance, however, remain in the sample.

Further, 70 companies, not operating option schemed were excluded as well. Some relevant information for a further 24 companies was either not available or could not be standardised over the two years for a number of reasons – mostly because of de-listings and mergers that took place. After these amendments, the sample shrank to 210 companies. Finally, I excluded 6 more companies from the sample for the following reasons: in 5 cases, the companies had newly appointed CEOs (less than a year of service in the boardroom), and, in the case of Bradford Properties, the company had two joint managing directors. It can be argued that these 6 cases are not comparable to the rest of the cross-sectional data (mainly in terms of accumulated share and option holdings), and,

therefore, should be dropped from the sample. Thus, a final sample of 204 CEOs and firms was constructed.

This sample represents the 204 largest UK-based publicly-traded firms which actively use options to remunerate their CEOs. The collected information comprises of CEO- level and firms-level information.

CEOs' level includes:

- CEOs' basic pay in 1997/98 (salary, bonus, benefits, annual increase in accrued pension)
- CEOs' holdings of ordinary shares at the financial year-end, 1998
- CEOs' option grants at the financial year-end, 1998
- Estimations of CEOs' LTIPs' value at the financial year-end 1998 (see Buck et al., 2004)
- CEOs' age and tenure on the board at financial year-end, 1998.

At a firm level, the data includes:

- Comprehensive information on corporate governance at the financial year-end 1998 (proportion of outside directors on the board, cases of dual (Chairman) role of the CEO, size of compensation and remuneration committees, cases of CEO membership at nomination committee, percentage of shares held by large outside investors, etc.)
- Firms' general financial information for 1997/98 (market value, share price, total sales, book value of total assets and total debt, R&D spending, etc.)

  The ratio of the market value to the book value of assets and debt (as obtained from DATASTREAM) is used as UK accounting analogy for Tobin's Q (see Short and Keasey (1999).
- Standard deviation of firms' share price logarithmic returns and firms' market beta for the three-year period, 1996-1998.
- Firms' financial performance in the 1998/99 financial year (total shareholder return).

It should be mentioned here that the final sample of 204 companies is obviously size-biased if it is considered to be representative of all UK based firms that actively use

options and other forms of equity to remunerate executives. This study clearly focuses on larger companies, therefore, and does not analyse small-cap UK firms. Although firm size is included in the models as a control variable, the study does not pretend that its findings are equally valid for UK businesses of all sizes.

6.3 The Design of Statistical Tests

This section describes the design of proposed statistical tests for the set of working hypotheses summarized in Chapter 5. The third in the list of objectives of this research, outlined in the beginning of Chapter 1, is to test empirically for the overall efficiency (measured by empirical relation with subsequent TSR) of executive option grants adopted in top UK companies and share-based incentives in the 1998/99 financial year. To do it successfully, we have to remember that executive option grants interact significantly with other corporate governance mechanisms, managerial power, informational and investment environment and, in general, are a part of a bigger picture of the governance – strategy – performance paradigm (see Figure 2).

The thesis predict a non-monotonic relationship between managerial equity and firm performance (H1), with option holdings having in general more desirable effect on firm value than managerial shares (H4). The efficiency of the actual option schemes will be moderated by managerial power concentration (CEO/Chairman duality) and managerial control over board dynamics (CEO chairing board's nomination committee) (H5). Non-monotonic ownership-performance relation will be more statistically significant in opaque environment with limited potentials for monitoring (H3a), with risk-related side-effects of equity-based pay being more damaging in firms with valuable investment opportunities and therefore the equity-based forms of managerial compensation being used less heavily in such firms (H3b). In addition, the effect of managerial risk-aversion on optimal equity-based pay will vary from firm to firm and will depend on what is currently perceived by the business as its sensitive side – choosing investment projects appropriately or ensuring waste minimization on the returns on these projects (H2).

All of the above hypotheses, with an exception of H2, are statistically tested in Chapter 7 with available data. Having in our possession a single cross-section we are going to use

ordinary least square models with heteroscedasticity-consistent standard errors and Huber/White/sandwich estimators of variance as our main source for statistical inference. Market to book ratio and TSR values are firm performance indices of choice in this study. Accounting measures as earnings per share (EPS), return on equity (ROE) and return on capital employed (ROCE) are often used in related studies as alternatives to market values. It is argued, however, that accounting measures are more susceptible to managerial manipulation in short run than the market consensus. In addition, forward-looking nature of market prices reflects time horizon of shareholders' objectives more fully than current accounting ratios. Of course, using market valuation does not completely hedge research on incentives against possible bias. For example, executives may adopt option grants in anticipation that the very announcement will raise the stock price (see Yermack, 1997).

Central explanatory variables of firm performance in our tests are forward-looking managerial financial incentives coming from managerial option and shareholdings. These incentives are conceptualised in two core indices: wealth-to-performance elasticity $WPE = \frac{\partial V_{tot}}{\partial P}\frac{P}{V_{tot}}$ and risk-return trade-off $RR = -\frac{\partial V_{tot} / \partial \sigma^2}{\partial V_{tot} / \partial P}$, where V_{tot} stands for risk-adjusted total managerial wealth. Ex-post option efficiency is tested with minimum assumed incentive effect of options MAIE = (Black-Scholes Option Value – Risk-adjusted Value) / Annual Cash Pay. It is helpful to remember as well that the product of first two indices gives wealth-to-risk elasticity $WRE \equiv \frac{\partial V_{tot}}{\partial \sigma^2}\frac{\sigma^2}{V_{tot}} = -RR * WPE * \frac{\sigma^2}{P}$. The following statistical analysis uses WPE to gauge for positive incentive effect and the product RR * WPE to estimate negative side-effects coming from associated distortions in managerial risk preferences. It is suggested here that the financial incentives created by the executive equity grants are of a mixed nature: they have positive and negative sides. High levels of RR * WPE signify high sensitivity of managerial total wealth to share price volatility which, as our prior analysis shows, may be detrimental to firm value. Our central theoretical conjecture is that empirical non-linearity between WPE and firm performance is a result of the moderation effect of managerial conservatism on the WPE – performance link.

Industry affiliation (by industry average R&D/Sales) is used to approximate firms' investment climate to estimate the amount of rewards which firm potentially get or loose in risk-taking activities (see section 3.3.2, hypothesis H2b). Additionally, industry affiliation (by industry average R&D/Sales) is used to estimate firm's predominant level of monitoring potentials by outsiders (H3a). It is argued, based on studies of Zeckhauser and Pound (1990), Milgrom and Roberts (1992), Guay (1999), that businesses in industries with high average R&D/Sales ratios both face higher rewards for efficient risk taking and are less transparent for the outsiders' monitoring and control.

The tests of our working hypotheses on the governance – strategy – performance link are designed to run in two steps. The results of our first step, devoted to uncovering the functional form of the relationship between managerial equity holdings and firms' value (hypothesis H1) are reported in Table 12. We start with the classical Morck, et al. (1988) type of regression of firms' market to book ratio (DATASTREAM based UK analogy for Tobin's Q). The main independent variable in this test is our proxy for the level of managerial involvement in their firms' equity: the total risk-adjusted wealth-performance elasticity WPE. Regression results confirm the non-linear quadratic form of the relationship, suggested by some Morck followers (see Table 2). However, this thesis argues that we are in need of further and deeper analysis. It is argued here that this Morck-style regression may serve as a good illustration on the resulting performance effects of managerial equity-based pay, but it does not explain how the incentives actually work and why we have this peculiar one-peak pay-performance relationship. This severely limits the explanatory power of any Morck-style regression since we don't know what shapes this relationship and, thus, affects the regression coefficients. It is therefore unsurprising that the regression results vary widely among numerous replications of the Morck analysis, although the general finding of the non-linearity of the pay-performance relationship has been confirmed by virtually every study.

This thesis suggests that in order to answer these questions "how" and "why" and to uncover the actual mechanics of the equity-based incentives one should improve the specification of the Morck-style regression and include variables for risk-related managerial incentives, such as the RR ratio. It is suggested here that the financial incentives created by the executive equity grants are of a mixed nature: they have positive

and negative sides, which basically might mean that a regression using a measure of the positive effect only might be mis-specified. This study attempts to fill this possible gap. It attempts to take into consideration the negative risk-related potentials of the CEOs' equity holdings by including the RR ratio index in the analysis.

Thus, the second column in Table 12 presents the development in our statistical analysis in order to test the simultaneous effect of WPE and RR on firm performance. Industry opacity dummy, constructed below, is present as environmental variable to test for H3a. The thesis argues that, for the purpose of short-term performance tests and isolation of incentive-performance causality firms' annual TSR is a better dependent variable than market-to-book ratio, since firms' annual TSR carries over less performance information related to past incentives. To completely solve the problem of causality with a single cross-section is, in general, very hard if not impossible (see discussion on internal validity in section 6.1). The cited prior researches were using both variables, but preferring TSR to market-to-book ratio is, in my view, a step forward. Since we are not interested in the fixed industry effects, firms' TSR is taken relative to the average industry figures.

We test the theoretical conjecture that empirical non-linearity between WPE and firm performance is a result of the moderation effect of managerial conservatism on the WPE – performance link. As managerial conservatism tends to rise with WPE, the efficiency of the equity-based incentives drops and the turning point occurs. The test results are consistent with the view that the equity-based incentives work well subject to low levels of induced managerial conservatism; high levels of managerial conservatism limit the aligning effect of equity and may even reverse the effect of incentives.

Next, the obtained functional form of incentive – performance link is supplemented with explanatory regressions on WPE and RR indices. The objective of these regressions being to test for the relative effect of shares and options on the positive effort-related side and the negative risk-related side of CEOs' financial incentives (hypothesis H4). In addition to the risk-adjusted value of the CEO's holdings of options and shares, one of the main explanatory variables here is the Average Exercise Price of the CEO's equity holdings. Assuming a zero exercise price of CEOs' shares, the average exercise price of CEOs'

equity holdings in the presence of N different option tranches is estimated as a simple proportion

$$\text{Average Exercise Price} = \frac{\#\text{options1} * \text{Exercise Price1} + ... + \#\text{optionsN} * \text{Exercise PriceN}}{\text{Current Share Price} * (\#\text{shares} + \#\text{options1} + ... + \#\text{optionsN})}.$$

This estimation is based on the quantity of shares and options involved, not on their estimated values. This obviously very rough approach to the "average" exercise price is taken here for two reasons. First, it would be misleading to use Black-Scholes risk-neutral option valuation for this purpose in this particular situation. Second, to be able to estimate the average exercise price based on the "true" risk-adjusted valuation, one should apply a "certainty equivalence" valuation to each option tranche for each CEO separately. This creates both computational and methodological problems. However, it will be shown that even the rough estimation of the average exercise price, based on the quantity of allocated options, serves our goal well and is highly correlated both with WPE and RR.

The second step of the analysis is designed for the purpose of testing hypotheses H5 which is about governance effects on the quality of actual incentives and H3b, testing for the effect of firms' investment opportunity set on the volume of equity-based tranches, with the results reported in Table 13. In this regard, the time directors have spent in their boards is found to be a very significant control variable of a dynamic process of equity accumulation by managers with their tenure.

Through grants of options, which often are annual, and various forms of grants of restricted stock (e.g. LTIPs), managers accumulate equity stakes over time. In addition, many firms require managers to commit their own money to the firm's equity. Given this, the rate with which CEOs accumulate their wealth in option and shareholdings over time might give us some insight into firms' expectations of the efficiency of equity-based pay and, simultaneously, might help to uncover conditions under which this practice becomes easy to abuse. To test for hypothesis H5 we test the effects of CEO/Chairman duality, independent nomination committees, board composition, nomination and remuneration committee size and large outside shareholdings (aggregate ownership by shareholders with

greater than 5 percent ownership each) on the rate of equity accumulation by managers, cost efficiency of options and resulted managerial conservatism.

CEO duality (one person is both a firm CEO and chairs its board) makes it easier for an opportunistic manager to influence compensation design (Westphal & Zajac, 1994). CEOs chairing boards' nomination committees have undue influence over board composition and dynamics (Bebchuk et. al. 2002), which may result in appointments of "easy to govern" board members (Zajac and Westphal (1996)) and further increase CEO influence over compensation practices. Large outside shareholders are often viewed as providers of better governance than dispersed investors (Tosi & Gomez-Mejia, 1989). Proportion of board directors present in nomination and remuneration committees may be a proxy for the power of such committees through their diversity and less likely collusion between the members.

The thesis suggests that an efficient equity-pay design would, first, ensure an appropriate cost-efficiency of options in terms of an increase in managerial WPE per unit of options' costs. Second, an efficient contract would control for the level of managerial conservatism due to equity-holdings in managerial possession (including shares and options), which we estimate with the risk-reward (RR) index. As we will have the general moderation effect of managerial conservatism tested by this time, the tests on governance effects will show under what conditions managerial conservatism elevates dangerously high to the levels sufficient to destroy the link between WPE and firm performance, thus testing H5.

A statistical test of the proposed hypothesis H2 is beyond the scope of the current analysis. We try to assess CEOs' financial incentives based on the simplifying assumption of a constant coefficient of risk-aversion ρ among CEOs. What hypothesis H2 effectively says is that the structure of the equity-based managerial pay should be individually tailored to each manager on the basis of his/her personal level of risk-aversion and the risk-sensitivity of the firm's business environment. Whereas R&D intensity might serve as a proxy for the firm's risk-sensitivity, it might be quite tricky to try to estimate individual level of CEO's risk-aversion using publicly available information only. This constitutes one of the gaps of the current research and of the "certainty equivalence" framework in its current development stage in general.

6.4 Descriptive Statistics

Descriptive statistics of the central variables in question are reported and discussed in this section. These include

- key parameters of firm performance: Market to book ratio and TSR
- Construction of Opacity Dummy as a proxy for opaque and risk-sensitive environment
- a breakdown of managerial wealth
- core indices of financial managerial incentives:

  estimated wealth – performance elasticity (WPE)

  estimated risk-reward trade-off (RR), illustrating managerial conservatism in risk-taking and industry opacity
- a breakdown of WPE and RR into share- and option-induced groups
- company cost of option grants and Minimum Assumed Incentive Effect (MAIE) of executive share options
- corporate governance variables (board composition, remuneration and nomination committee size, board composition and the percentage of the large outside shareholdings).
- CEO tenure in the board (years): time in years since CEO was first appointed to the board (this would include any time served by the director in a non-CEO capacity as well)

We start here with a descriptive analysis of the data on firm performance. Table 5 shows an industry breakdown of our two major indices of firm performance: market to book ratio and Total Shareholder Return. We can see, and it is not unexpected, that firm performance is heavily industry-dependent. There is large variation of median figures across industries. Our goal is to isolate the incentive-based cause of firm performance. Of course, and it is reflected in our hypotheses, industries benefit from managerial financial incentives unevenly. Different environments are hypothesised to require different approaches in incentive design. However, other industry-related factors obviously contribute to average industry returns. Thus, in order to isolate and compare incentive effects on firms from different industries, this study harmonises data by considering firm performance relative to their industry performances. In doing so, we eliminate the effects which influence whole

industries and focus mainly on firm-specific factors, as managerial pay. Regressions on the pay-performance relationship in the next section, therefore, use industry-adjusted market to book ratio and TSR.

Table 5. Industry Breakdown of Observed Market-to-Book Ratio and Total Shareholder Return in FTSE350 firms

Industry classification as reported by Datastream	Number of firms	Median Market to Book Ratio at the 1998 year end	Median Total Shareholder Return in 1998/99
Consumer Goods	23	2.33	7.6 %
Financials	33	1.02	0.2 %
General Industrial	61	1.67	- 16.1 %
Resources	9	1.53	-33.6 %
Services	69	2.04	6.6 %
Utilities	9	1.83	2.7 %
Total	**204**	**1.76**	**- 4.1 %**

We anticipate that non-monotonic ownership-performance relation will be more statistically significant in opaque environment with limited potentials for (or costly) monitoring (H3a), with risk-related side-effects of equity-based pay being more damaging in firms with valuable growth opportunities and options for risk-taking (H3b and H5). Zeckhauser and Pound (1990) argue that the higher the R&D intensity of the industry, the more close is the information structure of the industry and the more difficult it is for outsiders to make detailed assessment of the companies' likely prospects. Indeed, one may argue that the costs of monitoring due to the business information structure rises with innovations, since frequent innovations are likely to make decisions made by top executives complex and nonroutine (Hoskisson and Turk, 1990). Following this line of reasoning, this thesis constructs opacity dummy based on industry average R&D intensity.

Industry classification available in DATASTREAM is used to average R&D/Sales ratios. As in Zeckhauser and Pound (1990), industries with average R&D/Sales ratios above 1% are classified as opaque, industries with averages below 1% are called transparent. Table 6 presents the resulting list of opaque and transparent industries which will be used in our statistical tests. Zeckhauser and Pound admit that this 1% cut-off rule is somewhat arbitrary, nevertheless it produces intuitively plausible results. With exception of one industry, Utilities, the same opaque/transparent classification is obtained when the

industries are divided according to whether at least half of the firms report non-zero R&D expenditure. Utilities industry is relatively small in our sample, includes 9 firms only and does not significantly affect future analysis. Corresponded statistics on firms reporting non-zero R&D are included in Table 6.

Table 6. Design of the Opacity Dummy

Industry classification as reported by Datastream	Number of firms	Average R&D/Sales Ratios (%)	% Reporting R&D	Opacity Dummy value
Consumer Goods	23	9.4	78	1
Financials	33	0	6	0
General Industrial	61	1.26	74	1
Resources	9	41	100	1
Services	69	0	22	0
Utilities	9	0	89	0
Total	**204**	**3.3**	**47.5**	**-**

Guay (1999), on the other hand, uses R&D/Sales ratio as one of the key parameters in the factor analysis while estimating firm's investment opportunities (firm's risk-sensitivity in our classification). Indeed, in risk-sensitive firms with valuable investment opportunities and potentially higher rewards for efficient risk taking one would expect higher levels of R&D intensity. The thesis suggests that the risk-sensitive environment with high potential level of rewards for risk-taking creates higher monitoring costs situation through high R&D intensity and associated challenges in assessing and picking up worthy innovations. Thus, we assume interaction of hypotheses H3a and H3b through R&D intensity and suggest that industry average R&D intensity may serve as a proxy both for the level of information opacity and risk-sensitivity of firms' investment opportunities. Following the suggestions of Zeckhauser and Pound and Guay, this thesis uses the designed opacity dummy to test both for H3a and H3b.

Our next data summarised in Table 7 is the estimated structure of managerial wealth. As mentioned before, managerial wealth comprises the risk-free part of total assets that is not dependent on the firm's share price's ups and downs and on risky, equity-based returns. In turn, equity-based managerial wealth is split between shares and options. Using the

information disclosed in the annual reports, this research is able to assess the structure of managerial wealth across FTSE350 firms.

The risk-free part of managerial wealth is estimated to be the greater of £1m. and four times annual cash compensation. By CEOs' annual cash compensation we mean the sum of *salary + 0.8*bonus + benefits + annual increase in accrued pension*. Risk-free managerial wealth with the market (face) value of managerial shares and the Black-Scholes value of options together form the risk-neutral market valuation of managerial wealth. Corresponding average figures are reported in the second column in Table 7. Further, the risk-adjusted value of CEOs' shares and options is estimated by the "certainty equivalent" framework. Equation (4.9) is used to estimate total risk-adjusted managerial wealth. Columns 3 and 4 present mean and median values respectively. The same equation without options is used to estimate the managerial shareholding valuation. Table 7 reports significant variations of managerial wealth across industries. Our results confirm findings of Murphy (1987), Joskow, Rose and Wolfram (1996), Hubbard and Palia (1995) and Murphy (1999) with predominantly US data of relatively low CEOs' compensation levels in utilities and its high levels in financial sector. Finally, equation (4.4) is used to estimate the risk-adjusted value that managers put on their options. The relative significance of shares and options in the managerial wealth structure is represented in the last two columns in Table 7.

Table 7. The Structure of Risk-adjusted CEOs' Wealth (ρ = 4)

Industry	Risk-neutral valuation of total CEO's wealth (mean) (£m)	Risk-adjusted total CEO's wealth (mean) (£m)	Risk-adjusted total CEO's wealth (median) (£m)	Percent of CEO's wealth in ordinary shares (mean)	Percent of CEO's wealth in options (mean)
Consumer Goods	5.5	4.2	2.8	18.5 %	13.6 %
Financials	9.1	6.3	3.9	39.4 %	7.8 %
General Industrial	5.1	3.6	2.5	21.3 %	7.7 %
Resources	4.5	3.8	2.6	22.3 %	7.7 %
Services	7.5	5.1	2.8	26.2 %	11.6 %
Utilities	2.3	2.1	2.0	10.3 %	14.6 %
Total	**6.5**	**4.6**	**2.6**	**25.1 %**	**10.0 %**

The reader must be warned here that the absolute values in Table 7 are dependent upon the assumed level of managerial risk-aversion ρ. This analysis assumes ρ being equal to 4. Other possible levels of ρ were also considered (2, 3... 6). The assumption of the coefficient of risk-aversion being constant across all CEOs is evidently a simplification of reality. However, no apparent rule for the choice of the level of risk-aversion is found except for one qualitative test. Executives' private valuations of the option grants reflects the risk premium that is incorporated into the expected shareholder return (something that is diversified away in the Black-Scholes risk-neutral valuation). Nevertheless, it is widely accepted that top managers "undervalue" options due to inborn risk-aversion, i.e. CEOs value these options below their market valuation. This study assumes minimal ρ (ρ = 4), so that for almost all CEOs in the sample, with only a few exceptions, the risk-adjusted valuation of options is lower than their Black-Scholes value. Lower levels of ρ (for example ρ = 3) are found to be insufficient to outweigh the value-inflating effect of the risk premium (Following Fama and French (2001), the risk premium assumed to be 3.5 %).

While absolute figures in Table 7 are found to be assumption-sensitive, the relative cross-sectional differences of the computed values are robust and do not depend on the

assumptions for ρ. Thus, Table 7 suggests that while the risk-neutral market valuation of managerial packages varies greatly across industries, the variations in risk-adjusted values are actually more modest. This is due to the fact that wealthy leaders of Table 7 (CEOs in the financial and service sectors) have significant holdings of shares. From the managerial point of view, however, the value of option and shareholdings are subject to a risk discount. Table 7 suggests that the average CEOs' wealth in the financial sector is discounted much more and to a greater proportion than the average CEOs' wealth in the more conservative utilities sector. This finding does not depend on the choice of risk-aversion ρ.

This research argues that the value and structure of risk-discounted managerial wealth reflects managerial financial incentives for value creation more accurately than the risk-neutral Black-Scholes market valuation. Thus, it can be argued that granting large holdings of options and shares to top managers may be inefficient, since large equity holdings tend to be severely discounted in value by executives, with the opportunity costs of these discounts possibly exceeding their benefits in terms of additional incentives.

To study the efficiency of the practice of granting executive share option and to test Hypothesis 6, the firm's opportunity cost of option grants is calculated, given by the formula:

Company Cost = Black-Scholes value – Risk-adjusted option value.

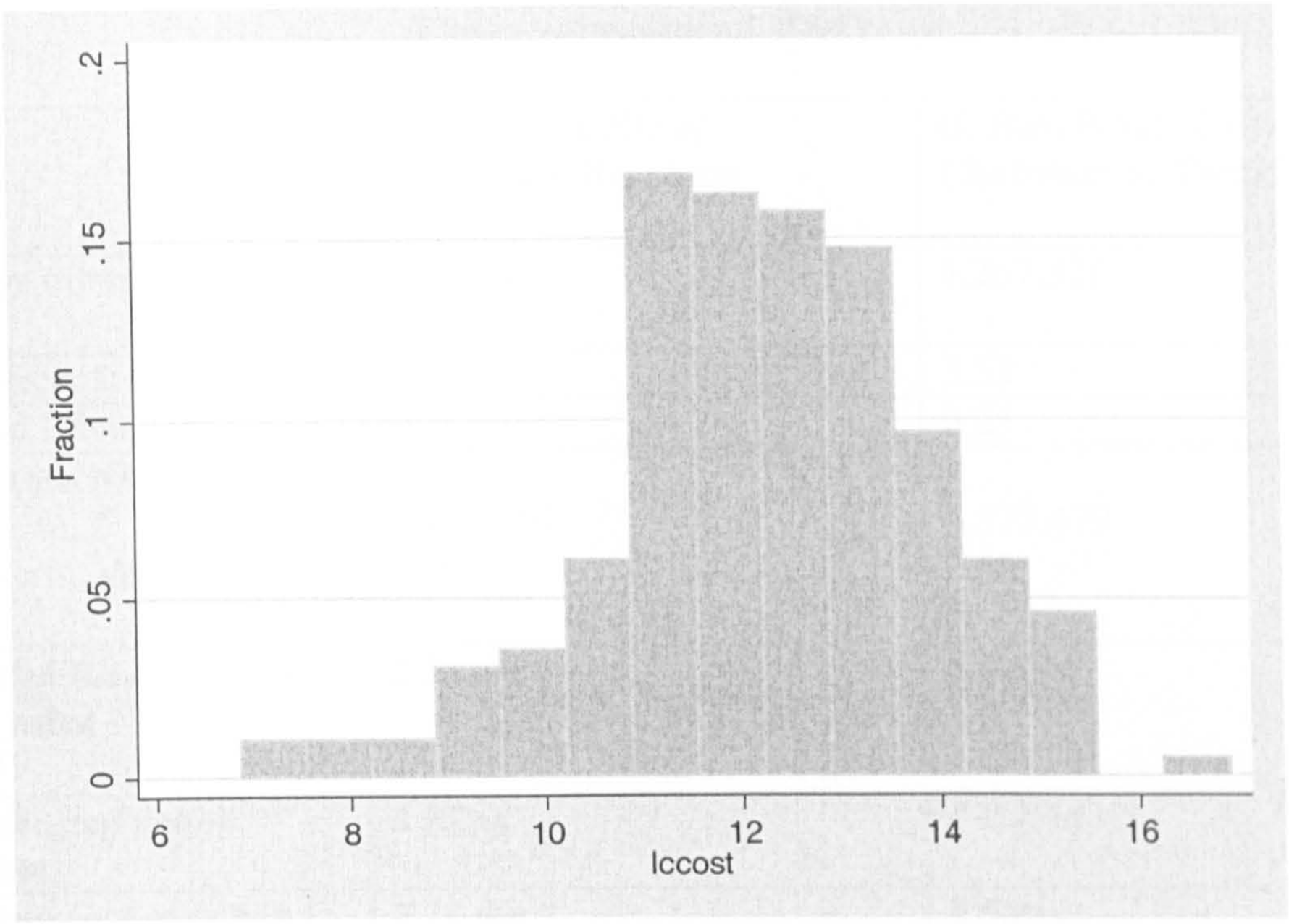
Further, we define the Minimum Assumed Incentive Effect for a CEO as the ratio of the Company Cost of option grants to the CEO's annual cash compensation

MAIE = Company Cost / Annual Cash Compensation.

The relationship between the opportunity costs of option grants measured either by MAIE or by the log of company cost and firm performance may reflect the efficiency of adopted option-based compensation plans. The histogram in Figure 15 describes the sample outcomes of the log of company cost, which can be seen to cover a wide range.

Figure 15. Log of the Opportunity Cost of Executive Options at the financial year-end, 1998

Histogram of Log (B-S cost – risk-adjusted option value)



Cells are evenly distributed between sample maximum and minimum. There are 14 cells, each approximately 0.67 in width. 7 firms with risk-adjusted valuation exceeding Black-Scholes cost are not included in here. Statistics for Log (B-S-cost – Risk-adjusted value):

Min:	P5:	Median:	Mean:	P95:	Max:	St.Dev
6.87	9.24	12.3	12.22	14.92	16.25	1.64

Statistics for MAIE = (B-S-cost – Risk-adjusted value) / Base Pay:

Min:	P5:	Median:	Mean:	P95:	Max:	St.Dev
-0.03	0.01	0.48	1.17	5.67	12.3	1.81

Thus, in the sample, the company's opportunity cost of adopted option schemes is distributed between exp(6.87) = £880 in the case of Sir P. Hunt, CEO of Land Securities, and exp(16.25) = £11.4 million in the case of J. Leschly , CEO of Smithkline Beecham. Facing this diversity, the question of the policy determinants and efficiency arises. There are two companies with the cost greater than £5m, Smithkline Beecham with CEO J. Leschly with an estimated company cost of £11.4m and Tomkins with CEO & Chairman

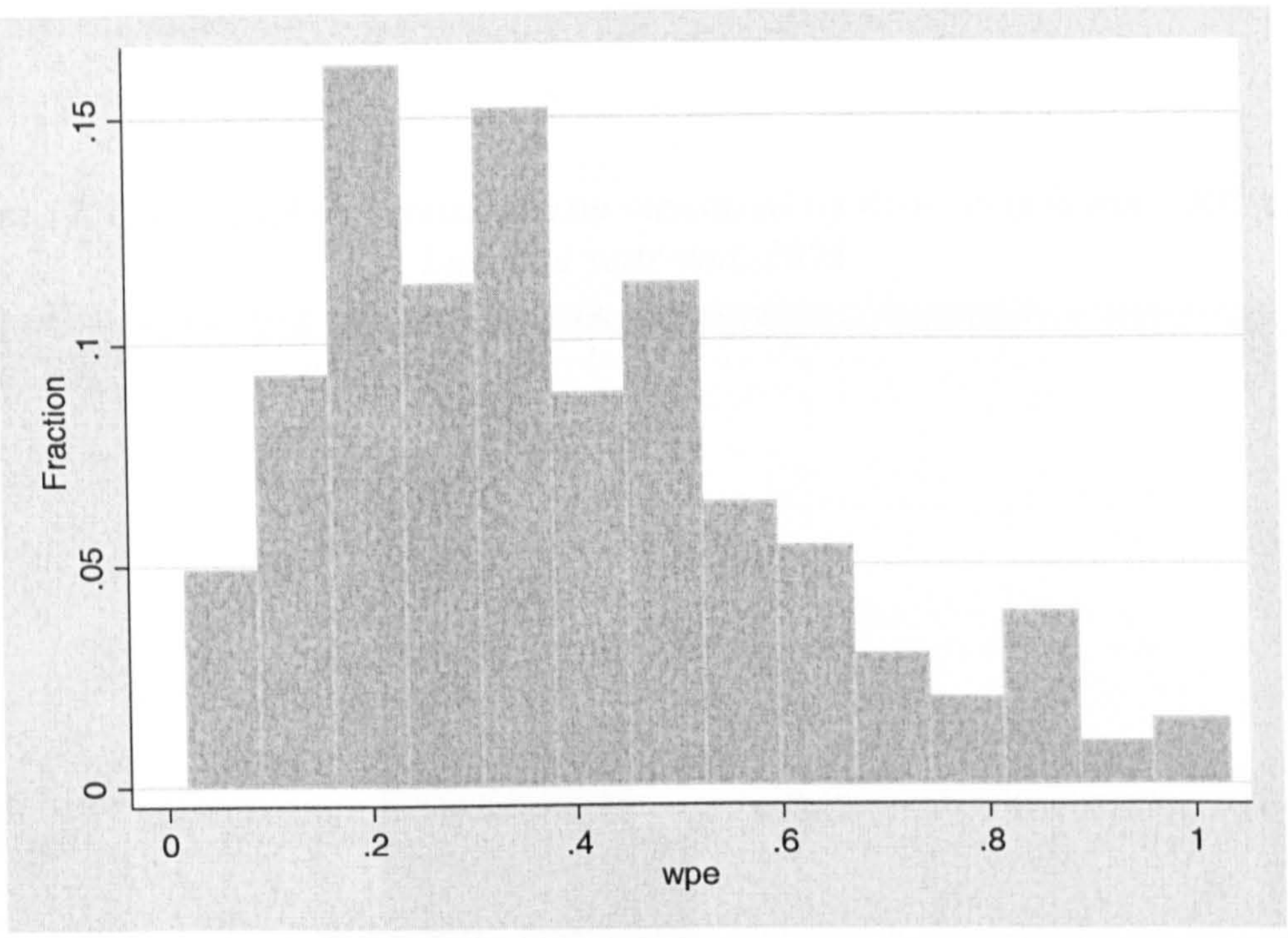
G. Hutchings, with an estimated company cost £5.8m. The following Table 8 summarises their equity profiles.

Table 8. Two Examples of Equity Profiles (Financial year-end 1998)

	J. Leschly, CEO of Smithkline Beecham	***G. Hutchings, CEO and Chairman of Tomkins***
Holdings of ordinary shares	882,064	8,267,329
Share price, £	6.23	3.52
Standard Deviation	0.23	0.25
Option tranch # 1 quantity, strike price, £ option term, years	4,919,016 2.58 6	5,573,479 2.58 5
Estimated Black-Scholes option value	***£ 18.6m***	***£ 6.58m***
Risk-adjusted option valuation	***£ 7.2m***	***£ 0.77m***
Company cost of option grants	***£ 11.4m***	***£ 5.8m***

The risk-adjusted Wealth-Performance Elasticity is shown in Figure 16. This is based on equation (4.10) and computes the relative (percentage) change in a CEO's total wealth, given a 1 % increase in the firm's share price: $WPE = \frac{\partial V_{tot}}{\partial P}\frac{P}{V_{tot}}$.

Figure 16. Risk-adjusted Wealth-Performance Elasticity of CEOs at the financial year-end, 1998



Cells are evenly distributed between sample maximum and minimum. There are 14 cells, each approximately 0.072 in width. Statistics for WPE:

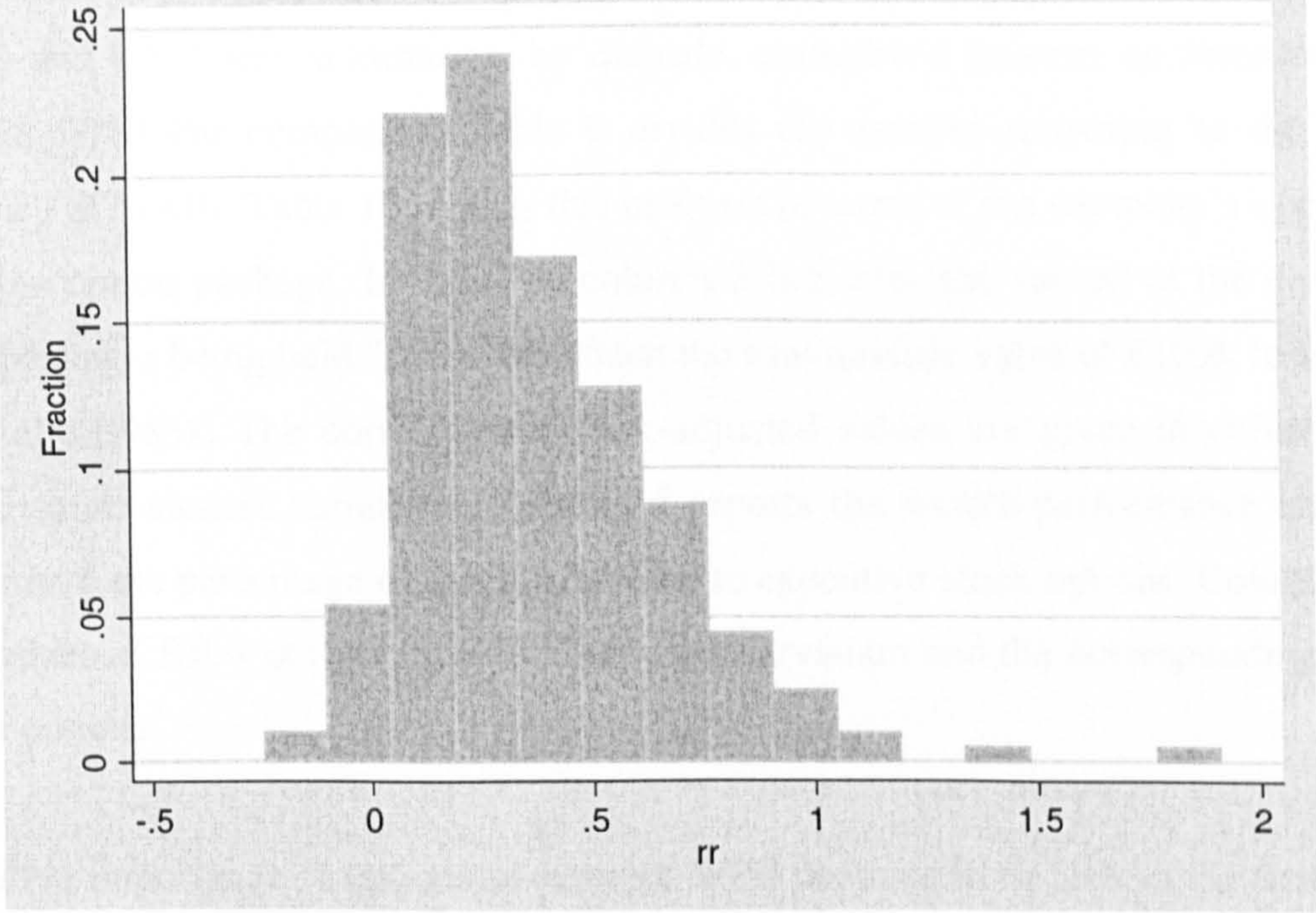
Min:	P5:	Median:	Mean:	P95:	Max:	St.Dev
0.018	0.09	0.34	0.38	0.83	1.03	0.22

Figure 16 shows that a 1 % increase in prices of their firms' shares would leave CEOs in the sample 0.018 % to 1.03 % better-off. The majority of the CEOs would benefit from a 0.1% - 0.8% increase in their total estimated wealth. For a median CEO, a 1% price appreciation would result in a 0.34 % increase in wealth.

Our next statistics is on the estimated level of CEOs' conservatism RR. We define the risk-reward ratio RR of total wealth as $RR = \frac{\partial P}{\partial \sigma^2}\frac{\sigma^2}{P}$, with the calculation based on equation (4.11). This risk-reward ratio calculates the percentage increase in share price that would off-set the effect of a 1% increase in the variance on total managerial wealth.

The histogram of estimated values is presented in Figure 17 with the estimates covering a wide range from –0.245 to 1.77. Negative values of RR (estimated in 8 cases) imply that the growth of share price variance increased private CEOs' wealth. These CEOs might have financial incentives to engage in risk-increasing projects even if these projects offer a negative present value.

Figure 17. Level of CEOs' conservatism measured by Risk-reward Ratio RR, at the financial year-end, 1998



Cells are evenly distributed between sample maximum and minimum. There are 14 cells, each approximately 0.14 in width. Statistics for RR:

Min:	P5:	Median:	Mean:	P95:	Max:	St.Dev
-0.245	0.016	0.32	0.37	0.87	1.77	0.28

The majority of CEOs, however, are apparently conservative in their investment appraisals. It is estimated that, from a purely selfish financial perspective, 90 % of CEOs would require between a 0.016 % and 0.87 % increase in share price for an expected 1 % increase in the firm's volatility (variance of share price). A median CEO in the sample would be satisfied with a 0.32 % price appreciation.

As we can see, equity holdings make CEOs financially dependent not only on the level of their firms' share price but also on the volatility of firm performance. That makes managerial business decisions biased towards less risky alternatives. Some of the firm resources may be used by conservative managers to over-protect the firm even if does not lead to better performance. Risk-neutral outside shareholders may find this inefficient. Thus, managerial equity holdings introduce a risk-related agency problem. The RR index may help us to quantify this potential cost of high-powered equity-based incentives.

Further detail on company opportunity cost of options, MAIE, WPE and RR is provided in Tables 9 and 10. These summarise, by quartile, considered indexes as recorded in the sample of FTSE350 companies. Table 9 divides the sample according to the relative importance of MAIE. Table 10 repeats this analysis in terms of the company's opportunity cost of the option package. In Table 9, column 3 indicates the spread of the cost of the options packages being held. These vary from the low-quartile value of £103k to the upper quartile of £1,983k. The corresponding risk-adjusted values are given in column 4 and show far more modest variations. Column 5 reports the wealth-performance elasticities and column 6 the percentage of this attributable to executive stock options. Columns 7 and 8 give values of RR – our measure of CEO's conservatism and the corresponding relative effect of options.

The relative importance of options in terms of WPE declines from 53% in the first quartile to 36% in the upper quartile. This indicates that CEOs with valuable option holdings are more likely to have significant shareholdings as well. Moreover, in the upper quartile, shareholdings clearly dominate in the equity structure of managerial wealth. Another important finding is that, with the first quartile being a single exception, options add to CEOs' conservatism rather than diminish it. Predominantly negative numbers in column 8 suggest that exercising and selling all option holdings would decrease CEOs' RR ratios.

TABLES 9 AND 10:

Notes on Columns:

1 – variable used to create quartiles

2 – number of observations falling within each quartile

3 – median B-S value of option grants held by executive, in £ thousands

4 – median risk-adjusted value of option grants, in £ thousands

5 – median risk-adjusted wealth-performance elasticity (WPE) of all holdings (shares + options)

Example: in the fourth quartile in the Table 9, WPE = 0.62 which means that the median CEOs' wealth of these firms grows by 0.62 % with every 1% increase in share price

6 – the fraction of WPE that is generated by option holdings

7 – the median risk-reward ratio of the CEOs' total wealth imposed by share- and option holdings. This serves as a proxy for the CEO's conservatism in risk-taking.

Example: in the fourth quartile in Table 9, RR = 0.55, which means that the negative effect of a 1% increase in share price variance on the CEOs' total wealth can be off-set by a 0.55 % increase in share price.

8 - relative effect of exercising and selling all option holdings on RR. If this figure is positive, options act to reduce the CEO's conservatism in risk-taking.

Table 9. Risk-adjusted Incentives and Minimum Assumed Incentive Effect

(1) Minimum assumed incentive effect MAIE = (B-S value – risk-adj. Value) / Base pay	(2) N Obs.	(3) Median B-S value £ thousands	(4) Median risk-adjusted option value £ thousands	(5) Median risk-adjusted WPE	(6) Part of WPE generated by option holdings (median value)	(7) Median RR ratio of CEOs' total wealth	(8) Relative effect of exercising and selling all options holdings on RR (median value)
MAIE < 0.166 (low company cost)	51	103	75	0.18	53 %	0.11	+ 10 %
0.166 < MAIE < 0.482	51	313	184	0.33	50 %	0.26	- 6.4 %
0.482 < MAIE <1.17	51	613	240	0.37	42 %	0.38	-11.5 %
MAIE > 1.17 (high company cost)	51	1,983	563	0.62	36 %	0.55	-7 %

Table 10. Risk-adjusted Incentives and the Company Opportunity Cost of Options

(1) Company opportunity cost of options = B-S value – risk-adj. Value	(2) N Obs.	(3) Median B-S value £ thousands	(4) Median risk-adjusted option value £ thousands	(5) Median risk-adjusted WPE	(6) Part of WPE generated by option holdings (median value)	(7) Median RR ratio of CEOs' total wealth	(8) Relative effect of exercising and selling all options holdings on RR (median value)
Ccost < 65,000 (low company cost)	51	90	62	0.18	52 %	0.12	+5 %
65,000 < Ccost < 202,500	51	296	207	0.34	46 %	0.24	-7 %
202,500 < Ccost <519,000	51	595	211	0.36	45 %	0.38	-10.8 %
Ccost > 519,000 (high company cost)	51	2,175	680	0.62	41 %	0.55	-11.7 %

Finally, this section presents the descriptive statistics for corporate governance variables. These will be used to test Hypotheses 6 concerning a correlation between the quality of executive option grants and the overall quality of corporate governance. Various measures of corporate governance quality are considered by this study, see Table 11A.

Table 11A. Descriptive statistics for corporate governance variables

Variable	Mean	Median	P5	P95	Standard Deviation
Board size	11.3	11	7	18	3.48
Board Composition = (# outside directors / board size)	0.51	0.5	0.33	0.75	0.127
CEO/Chairman duality dummy	0.26	0	0	1	0.442
Independent Nomination Committee dummy (nomination committee exists and not chaired by CEO	0.63	1	0	1	0.485
Nomination committee size = (# of directors in nomination committee / board size)	0.28	0.3	0	0.62	0.216
Remuneration committee size = (# of directors in remuneration committee / board size)	0.38	0.38	0.13	0.6	0.118
Percentage of large outsize shareholdings (aggregate ownership of shareholders with greater than 5 % ownership each)	0.26	0.22	0.03	0.57	0.17
CEO tenure in the board (years)	9.4	8	1.25	23	7.24

One of the main characteristics of corporate governance, considered both by researchers and policymakers (Cadbury Report (1992) and Greenbury Report (1995)) to be a flawed practice, is a dual Chairman role of CEOs. It is often argued that the dual role of CEOs diminishes the monitoring potentials of the board of directors, accumulates excessive

power and decreases the overall accountability of CEOs. Zajac and Westphal (1996), with data on 491 directors from Forbes and Fortune 500 indices, found that powerful top managers prefer to fill their boards with members with experience in other passive boards and exclude individuals with experience in more active boards. Therefore, it may be hypothesised that powerful CEOs tend to form "easy-to-govern" boards, and thus, a CEOs' dual role is negatively related to the design quality of equity-based incentives. Boards of directors have several mechanisms to monitor CEOs and balance excessive CEOs' power. One of these mechanisms is the board's nomination committee. Nomination committees, if independent of CEOs, control the quality and composition of boards, preventing CEOs, for example, from abusing their power and forming "easy-to-govern" boards. Optimal allocation of corporate governance monitoring resources, therefore, would ensure independent nomination committees in firms with dual CEO role, since the threat to CEO accountability in such firms is the greatest. However, every protective mechanism may sometimes be bypassed, and some CEOs (especially those with dual roles on the board) are found also to be heads of nomination committees, which, of course, make such committees inferior as governance institutions.

We illustrate the empirical evidence of interaction between CEO duality and CEO formal control over board composition, consistent with the finding of Zajac and Westphal (1996), with Table 11B. Table 11B divides the sample into four groups according to CEO duality as Chairman and to the formal control over board dynamics, measured by the existence of an independent nomination committee. Firms with no dual role of CEOs are placed in the first row. Firms with CEO/Chairman duality are in the second row. Correspondingly, boards with high assumed CEO power over board dynamics (nomination committees either do not exist or are chaired by CEOs) are placed in the second column. The first column represents firms with independent nomination committees and, thus, lower potentials for CEO control.

Table 11B shows that out of 150 companies with the Chairman role being separated from the CEOs' role (first row) more than two-thirds have independent nomination committees. In contrast, among 54 firms with CEO dual power, only 21 (less than 40%) may challenge their CEO/Chairman with independent nomination committees. These apparent empirical complementarities between CEO duality and CEO control over board dynamics may be

interpreted as the failure of the protective mechanism of corporate governance when it is most needed.

Table 11B. Interaction (complementary effect) between CEO/Chairman duality and CEO control over board dynamics

CEO control over board dynamics

CEO/Chairman duality

	Independent nomination committee	Nomination committee does not exist or is chaired by CEO
No dual role	**# of cases: 107** CEO tenure in the board (median, years): **7** Mean board composition: **52 %** Large outside shareholdings: **20 %** Median WPE: **0.31** Median RR ratio: **0.28** Median MAIE: **0.39**	**# of cases: 43** CEO tenure in the board (median, years): **8** Mean board composition: **52 %** Large outside shareholdings: **26 %** Median WPE: **0.36** Median RR ratio: **0.38** Median MAIE: **0.51**
CEO/Chairman dual role	**# of cases: 21** CEO tenure in the board (median, years): **9** Mean board composition: **54 %** Large outside shareholdings: **16 %** Median WPE: **0.37** Median RR ratio: **0.30** Median MAIE: **0.45**	**# of cases: 33** CEO tenure in the board (median, years): **13** Mean board composition: **49 %** Large outside shareholdings: **22 %** Median WPE: **0.51** Median RR ratio: **0.44** Median MAIE: **0.83**

Indeed, median CEO tenure on the board increases with CEO control over board composition. This effect is most significant in the case of the more powerful CEOs - median tenure rises from 9 to 13 years as the nomination committee ceases to be independent. Bearing in mind that the median CEO in the sample has become a board member after the age of 45 years, average 13-year service brings managers close to retirement age, suggesting that the dual role of CEOs without challenging threats from the board makes the CEOs' position of power effectively lifetime one, or at least lasting as long as CEOs wish. Obviously, this indicates a heavy entrenchment of the CEO, and

corporate governance cannot plausibly be assumed to be strong and effective under the described circumstances.

It is hypothesised here that power concentration in the hands of CEOs is negatively related to the efficiency of equity-based pay practice, since power abuse by these CEOs becomes more likely. Table 11B reports the medians of WPE, RR and MAIE for four subgroups under consideration. It shows that both CEO/Chairman duality and CEO control over board composition and dynamics may be associated with CEOs being more involved in firms' equity (higher WPE), being more conservative (higher RR) and having more costly option grants (high MAIE). This result becomes especially strong for 33 companies where the two measures of managerial power complement each other. We will later refer to these cases as to the cases of *concentrated* managerial power. Under the CEO duality, the firms' spending on the median holding of executive options almost doubles if nomination committee ceases to be independent (median MAIE elevates from 0.45 to 0.83).

Thus, we can see that some corporate governance variables may affect the extent to which equity-based incentives are used, but do they affect the quality of these incentives? Being a very interesting illustration, this descriptive result by itself does not allow us to draw any conclusion on the effect of corporate governance variables on the quality of involved incentive contracts. It should be mentioned, as well, that these descriptive results on medians are discussed here for illustrative purposes only, and all relevant t-tests and other significance tests will be carried out in the next section.

We complete the descriptive results of Table 11B with median values of the proportion of firms' ordinary shares owned by large outside shareholders ("large outside shareholdings"). Median values show a negative correlation between large outside shareholdings and managerial power (supporting control potentials of the former), and a substitution effect between outside shareholdings and independent nomination committees as two governance mechanisms.

CHAPTER 7. Statistical Inferences

7.1 Hypotheses Testing

This section test results of the explicit single equation multiple regression models of the relationships proposed by the working hypotheses and designed in section 6.3. Market to book ratio and TSR are two alternative measures of company performance. Pay-performance tests on both these measures are conducted in the analysis, adding to the research validity.

7.1.1 Performance tests

As described in section 6.3, we run the tests in two steps. Step one is performance tests, devoted to uncovering the functional form of the relationship between managerial equity-based incentives and firms' value (hypotheses H1, H3a, H4 and H5). Table 12 presents the results of the incentives - performance analysis.

Column one reports the results on our adaptation of Morck-type regressions. As predicted by hypothesis H1, the non-monotonous one-peak relationship between managerial equity involvement (WPE) and the log of market to book ratio is found. Since we are focused on relative effects, market to book ratio is industry adjusted and dummy variables for the Telecom and Information Technology sectors are used to control for the infamous IT & Telecom share price bubble. Calculations of T-statistics in Table 12 are based on the Huber/White/sandwich estimator of variance, available in the STATA statistical package to control for possible heteroscedasticity. To assess the overall fit of the model, Table 12 shows F-statistics and R^2.

The quadratic fit estimates that the level of WPE of approximately 0.8 is associated with maximum firm value (market to book ratio). Linear postestimation tests on regression coefficients suggest that increase in WPE from 0.4 to 0.8 would lead to the statistically significant and important in practice 25 % increase in market to book ratio. Rather high value of chi2(1) statistics of 3.32 in Cook-Weisberg test might suggest the presence of heteroscedasticity. However, our main problem with Model 1 is more profound: it is

argued here that Model 1 averages out the effect of managerial conservatism which remains unaccounted for and, additionally, suffers from the simultaneity problem of reverse causality running from current firm market value to current levels of incentives.

The second column in Table 12 presents the development in our statistical analysis in order to test the simultaneous effect of WPE and RR on firm performance. Industry opacity dummy is included as environmental variable to test for H3a and H3b. This regression uses subsequent firms' TSR (1998/99 financial year) as a dependent variable in an attempt to isolate the pay - performance effect from the opposite causality. Since we are not interested in the fixed industry effects, firms' TSR is industry adjusted.

Throughout, in our analysis it is suggested that high levels of RR index may reduce the efficiency of equity-based incentives, thus the incentive-performance relationship in our specifications is modelled as:

$$TSR = \alpha + \beta_1 * WPE + \gamma_1 * RR * WPE + \beta_2 * Opacity * WPE + \gamma_2 * Opacity * RR * WPE + \text{control variables} + \varepsilon \quad (7.1).$$

Positive coefficients β_i and negative coefficients γ_i, $i = 1, 2$ are expected. Coefficients β_2 and γ_2 would represent the effect of firm information environment and investment opportunity set on TSR sensitivity to CEOs' incentives and would test hypotheses H3a. Apart from its standard statistical interpretation as a measure of moderation in WPE – TSR link due to the level of conservatism RR, the product term RR * WPE represents the elasticity of managerial wealth to firm risk (WRE), introduced in section 2.8.4 of the introductory chapter[1] and is discussed in Section 6.3 of Chapter 6.

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[1] Section 2.8.4 introduces WRS index, which is tightly related to WRE: $WRS = \frac{\partial V_{tot}}{\partial \sigma^2}$, whereas $WRE = WRS \frac{\sigma^2}{V_{tot}}$, following common definitions of sensitivity and elasticity in economics. So that $RR * WPE = WRE \frac{P}{\sigma^2}$.

Table 12. Performance Tests (OLS with Heteroscedasticity-consistent standard errors)

Tested hypotheses and effects	H1, Adaptation of Morck regression	H3a & H3b Effort- and Risk-related effects	H4 Explanatory regressions on incentive-related indices	
Dependent Variables	(Model 1) Log of market to book ratio, Industry adjusted	(Model 2) TSR, Industry adjusted	(Model 3) WPE	(Model 4) RR ratio
Independent Variables				
WPE	2.28++ (3.51)	-.025 (-0.16)		
WPE * Opacity Dummy		.52++ (2.37)		
WPE^2	-1.43++ (-2.28)			
WPE * RR		.15 (0.65)		
WPE * RR * Opacity Dummy		-1.08++ (-2.56)		
Log of Basic Pay			-.18++ (-15.799)	-.08++ (-3.488)
Log of risk-adjusted CEO's equity value			.16++ (25.759)	.14++ (12.238)
Log of risk-adjusted CEO's option holdings			.05++ (7.755)	-.04++ (-3.854)
Average Exercise Price of CEO's equity holdings			.1++ (6.278)	-.16++ (-4.196)
St. Dev.			-.36++ (-6.156)	2.2++ (9.985)
Telecom sector dummy	++	++		
Information technology sector dummy	++	++		
Intercept	-0.63++ (-4.66)	-.08 (-1.57)	-.05 (-0.471)	-.61++ (-2.606)
R^2	16%	13%	93%	75%
F-statistics	9.52	12.55	277.75	59.98

T-statistics based on robust Huber/White/sandwich estimator of variance are reported in parentheses

++ $p < 5\%$

+ $5\% < p < 10\%$

The regression (7.1), presented in the second column (Model 2), shows that, in an opaque business environment, firm performance is statistically sensitive to the equity-based incentives WPE ($\beta = \beta_1 + \beta_2 = -0.025 + 0.52 = 0.495$). It shows as well that this sensitivity is significantly moderated by managerial conservatism RR ($\gamma = \gamma_1 + \gamma_2 = 0.15 - 1.08 = 0.93$). Average values of WPE and RR * WPE across the sample is 0.39 and 0.167 correspondingly. Thus, joint effort- and risk-related effect of the average CEO's equity-holdings is associated with almost four percentage point's increase in TSR of a risk-sensitive opaque firm ($0.495 * 0.39 - 0.93 * 0.167 = .038$). This positive composed effect, however, might deteriorate if the level of CEO's conservatism increases.

In a relatively transparent business environment with low levels of R&D spending, the regression fails to detect significant incentive-performance correlation, consistently with H3a. This does not mean, obviously, that this correlation does not exist in a transparent environment, it may however suggest that the firm performance sensitivity to the departures from the optimal contracts here is of a lower magnitude due to more efficient monitoring and thus is harder to detect.

The presented regression results seem to be consistent with the hypothesised dual effect of equity-based managerial pay and support the proposition that empirical non-linearity between WPE and firm performance is a result of the moderation effect of managerial conservatism on the WPE – performance link. As managerial conservatism tends to rise with WPE, the efficiency of the equity-based incentives drops and the turning point occurs. The results are consistent with the view that the equity-based incentives work well subject to low levels of induced managerial conservatism; high levels of managerial conservatism may limit the aligning effect of equity and may even reverse the effect of incentives.

The performance tests are supplemented with explanatory regressions on WPE and RR indices in columns 3 and 4 of Table 12 correspondingly. The objective of these regressions is to test for the relative effect of shares and options on the positive effort-related side and the negative risk-related side of CEOs' financial incentives (hypotheses H4 and H5). Effort-related and risk-related indices WPE and RR are regressed on variables representing the structure of managerial wealth: the log of basic pay, the log of

total risk-adjusted managerial equity holdings and the log of risk-adjusted value of options.

On average, both WPE and RR increase with Log of total value of equity holdings – managerial wealth becomes more dependent both on share price and share price volatility as their equity holdings increase in value. However, coefficients of the log of option holdings in these two regressions suggest that options provide a higher than average increase in WPE and result in a slower rise in RR. Results show that grants of at the money options double WPE, comparing to shareholdings of the same value (general equity coefficient is 0.16, whereas at the money options add 0.05 + 0.1 = 0.15 to this figure). In addition, at the money options also do not appear to increase the level of managerial conservatism RR (regression 4, Table 12). Bearing in mind the results of Model 2 of a positive effect of WPE on firm value subject to low level of RR index we may infer that options, on average, may boost incentives and firm performance more effectively than shares through increased WPE relative to RR, in support of H4.

Controlling for total equity value, the average exercise price of CEO equity holdings is found to be positively associated with WPE and negatively related to RR. All firms, therefore, may benefit from keeping executive conservatism RR low by maintaining higher exercise prices upon option grants, and the corresponding gain should be more noticeable in a risk-sensitive environment.

7.1.2 Testing Determinants of Pay Structure: Equity Holdings Accumulation and H6

Having tested incentive – performance hypotheses H1, H3a and H4 in the previous section and having acknowledged that hypothesis H2 is beyond the scope of the current analysis (see section 6.3), we proceed with the tests on the effect of corporate governance on pay structure and incentive indices (hypotheses H5 and H3b).

Hypothesis H5 states that the efficiency of the actual option schemes will be moderated by managerial power concentration (CEO/Chairman duality) and managerial control over board dynamics (CEO chairing board's nomination committee). An efficient equity-pay

design would, first, ensure cost-efficiency of options in terms of an increase in managerial WPE per dollar of options' costs. Second, an efficient contract would control for the level of managerial conservatism induced by equity holdings (including shares and options), which we estimate with the risk-reward (RR) index.

As we see from the regression results reported in Table 12, the efficiency of the equity-based incentives is subject to the moderation effect of managerial conservatism and incentives work well under low levels of RR index. The tests on governance effects will show under what conditions managerial conservatism elevates dangerously high to the levels sufficient to destroy the link between WPE and firm performance, thus testing H5.

First three columns of Table 13 summarise the OLS results of governance effects on three central components of compensation costs: cash pay, shares and option holdings (all at the financial year end 1998). Tests on cost-efficiency of option grants, as measured by Log (ΔWPE / MAIE) and managerial conservatism RR are reported in the fourth and fifth columns correspondingly.

Explanatory variables are chosen in conjunction with our theoretical set-up. They may be divided into:

A) Corporate governance variables

- Concentrated CEO Power dummy; equals 1 if CEO chairs the board and its nomination committee or CEO chairs the board and nomination committee is not established. Represents cases of CEO duality with formal control over board dynamics (total of 33 cases, see Table 11B).
- Board size = number of directors on the board (see Table 11A for the descriptive statistics)
- Nomination Committee size = number of directors in the committee / Board Size; 0 if nomination committee does not exist (see Table 11A)
- Remuneration Committee size = number of directors in the committee / Board Size; 0 if remuneration committee does not exist (see Table 11A)
- Percentage of firm's outstanding shares owned by large outside shareholders (see Table 11A)

- CEO's tenure on the board (see Table 11A).

B) Environment variables

- Firm size, i.e. log of firm sales in 1997/98 (to represent the direct firms' competition for top managers)
- An opaque industry dummy, a measure of industries' information structures and investment opportunities (see Table 6 for its construction)

C) Control variables

- Standard deviation of logarithmic returns on firm's shares
- Firm's market beta.

Adjusted R^2 and F-statistics are reported near the bottom of the Table. To control for threats of heteroscedasticity, calculations of T-statistics in Table 12 is based on the heteroscedasticity-robust Huber/White/sandwich estimator of variance, available in the STATA statistical package.

The first dependent variable analysed in Table 13 is the log of basic (cash) pay. Unsurprisingly, a strong correlation between basic pay and firm size is found. Employees' competition for quality managers on labour market is one plausible explanation here. On average, as sales volume doubles, executive cash compensation increases by 15% ($2^{0.2}$-1 = 0.149). This figure is slightly lower than estimated 23% in the USA (Baker, Jensen and Murphy (1988), Rosen (1992)).

Reported positive effect of CEO/Chairman duality on CEOs' cash rewards is statistically significant. CEOs' basic pay is on average 13% higher if they chair their boards (exp(.12) – 1 = 0.127). Effect of independent nomination committee is of a lower degree of statistical significance and was excluded from the regression. Corporate governance variables as board composition, nomination and remuneration committee size and large outside shareholdings are found to have no statistically significant effect on CEO cash compensation.

The second column of Table 12 analyses CEOs' holdings of their firms' shares. The Logarithm of the market value of CEOs' shareholdings is found to be highly correlated with the time that CEOs have spent on the board and with CEOs' basic (cash) pay.

Through grants of options, which often are annual, and various forms of grants of restricted stock (e.g. LTIPs), managers accumulate equity stakes over time. In addition, many firms require managers to commit their own money to the firm's equity. Given this, the rate with which CEOs accumulate their wealth in shareholdings over time might give us some insight into firms' expectations of the efficiency of equity-based pay and, simultaneously, might help to uncover conditions under which this practice becomes easy to abuse.

As CEOs' annual cash pay often serves as a "yardstick" that firms use to design financial incentive schemes, cash pay may form the basis for the share accumulation process. I model the share accumulation process as:

$$\text{Value of Shares / Basic Pay} = \alpha\, T^{\beta} \exp(\varepsilon),$$

where T is the CEO's tenure (the time in years that the CEO has spent on the board) and $\exp(\varepsilon)$ is the error term. Environment variables are expected to affect the overall attractiveness of equity-based pay (the multiplier α), whereas corporate governance variables may influence the dynamics of the share accumulation process, captured by the power term β. If the power β is below 1, we have a concave growth which moderates with time and would probably represent saturation in managerial shareholdings. The case of $\beta = 1$ describes time proportional growth where the shares' annual appreciation is proportional to the annual managerial cash pay. If β exceeds 1, the managerial shareholdings grow faster than the amount of the firm resources spent on managerial cash pay which may happen if, for example, influential CEOs find a way to grant themselves increasingly costly equity tranches.

Governance effects test for H5 and are expected to be captured in the model by assuming the following multiplicative form of the power term

$\beta = \beta_0 + \beta_1$ * Concentrated CEO Power Dummy + β_2 * Nomination Comm. Size +
β_3 * Remuneration Comm. Size + β_4 * Board Composition +
β_5 * Large Outside Shareholdings.

Table 13. Determinants of CEOs' Compensation Costs: Hypotheses H5 and H3b (OLS with Heteroscedasticity-consistent standard errors)

Test: Dependent Variable	(1) Cash: Log of basic pay	(2) Share accumulation: Log (market value of CEO shares / basic pay)	(3) Cost of CEO's Options Log (MAIE) = Log (option costs / basic pay)	(4) Cost efficiency of option grants: Log (Δwpe / MAIE)	(5) CEO's conservatism due to firm-specific risk Risk-return trade-off (RR)
Firm's Size	.20++ (10.93)	-	-	-	-
CEO/Chairman duality	.12++ (2.07)	-	-	-	-
Opacity dummy	-	-.535++ (-2.35)	-.611++ (-2.72)	.568++ (2.61)	-
Log of CEO's Tenure	-	1.63++ (6.6)	3.69++ (3.61)	-1.01++ (-4.12)	.367++ (3.27)
Log of CEO's Tenure * Concentrated CEO Power Dummy	-	.359++ (2.34)	.231+ (1.86)	-.284++ (-1.98)	.041++ (2.00)
Log of CEO's Tenure * Nomination comm. size	-	-.519++ (-2.07)	-.224 (-1.05)	-	-.073++ (-2.19)
Log of CEO's Tenure * Remuneration comm. size	-	-	-	-	-
Log of CEO's Tenure * Board composition	-	-.816+ (1.83)	-.620 (-1.36)	1.15++ (2.78)	-
Log of CEO's Tenure * Large outside shareholdings	-	-	-.430 (-1.41)	-	-
(Log of CEO's Tenure)^2	-	-	-.765++ (-3.86)	-	-.059++ (-2.16)
St. Deviation of firm's share price (%)	-	-	.051++ (3.86)	-.093++ (-6.71)	.019++ (5.65)
Intercept	8.71++ (22.47)	-2.23++ (-5.97)	-5.12++ (-5.01)	1.84++ (3.72)	-.634++ (-3.96)
R^2	38 %	37%	16 %	31 %	37 %
F-statistics	63.12	22.92	4.89	19.42	14.14

T-statistics based on robust Huber/White/sandwich estimator of variance are reported in parentheses ; ++ $p < 5$ %; + 5 % $< p <$ 10 %

The second column of Table 12 presents the regression results for the logarithmic transformation of the share accumulation process:

$$\text{Log (Value of shares / Basic pay)} = \alpha_1 + \alpha_2 * \text{ECV} +$$
$$(\beta_0 + \beta_1 * \text{Concentrated CEO Power} + \beta_2 * \text{Nomination Comm. Size} +$$
$$\beta_3 * \text{Remuneration Comm. Size} + \beta_4 * \text{Board Composition} +$$
$$\beta_5 * \text{Large Outside Shareholdings}) * \text{Log of Tenure} + \varepsilon,$$

where ECV denote environment and control variables: firm size, opacity dummy and standard deviation of firm's share price.

The results show that, consistent with hypotheses H3b, the "opaque industry" dummy is negatively related to the multiplier α, providing evidence that R&D intense industries use less powerful financial incentives, possibly because they face more severe risk-related agency problems. Specifically, the average CEO's shareholdings in the opaque industries is 42% lower than in the transparent (exp (-0.54) – 1 = -0.42).

The results show a strong support for the process of managerial equity accumulation with tenure. The total effect of the log of tenure (fixing other variables at their sample means) is statistically significant and equals 1.12 (T-statistics of 6.76). This would suggest that an average CEO with median tenure (8 years) has 2.17 times the equity of an average CEO with lower quartile tenure (4 years).

Among the corporate governance variables, the regression finds statistically significant effects of concentrated managerial power (as measured by CEO/Chairman duality and CEO control over board dynamics, see definition above), nomination committee size and weakly significant effect of board composition. The results on the share accumulation dynamic suggest that, on average, the CEO's shareholdings grow proportional to the CEO's tenure, if CEO's power is low: $\beta = \beta_0 + \beta_2 * \text{Mean Nomination Comm. Size} + \beta_4 * \text{Mean Board Composition} = 1.63 - 0.519 * 0.28 - 0.816 * 0.51 = 1.07$. The concentration of power in the hands of CEOs, on the other hand, is associated with a significant acceleration in CEOs' share accumulation rates and adds 0.359 to β which makes the total of $\beta = 1.43$ (other parameters are still fixed on sample means). This means that CEO of a

twice longer tenure is associated with almost three times more valuable shareholdings, $2^{1.43} = 2.7$ (i.e. CEOs' wealth-time proportionality under managerial power concentration does not hold). The hypothesis of a proportional share accumulation (i.e. $\beta = 1$) is rejected at the 99% confidence level.

Independent effects of CEO chairing nomination committee and CEO/Chairman duality (which together constitute managerial power concentration in our set-up) are of a lower degree of statistical significance than the joint effect, which points to the complementarities between these two factors in their effect on the equity-pay practice. This result might strengthen suspicions of possible abuses of the practice of equity-based pay (as a relatively opaque form of reward) by powerful, uncontrolled CEOs.

Obviously, this equity accumulation model is also applicable to CEOs' options. Column 3 shows the results of the accumulation process regression applied to the proxy of firm's opportunity costs of options – MAIE index. Applying the model to executive options one has to account for the limited option term and the rotation of options in managerial package (the maximum option term among all studied executive options is ten years). Option grants usually become exercisable as soon as three years after the grant. Therefore, following an initial rise in option holdings with tenure, one could expect a more subdued growth or a saturation in option value once CEOs have begun to exercise the tranches close to maturity.

The regression on options in column 3 reflects this possible saturation with quadratic term $(\text{Log of Tenure})^2$. Apart from that, the regression set-up copies our model for share accumulation. Regression results show that both the linear and the quadratic terms of CEOs' tenure are highly significant, confirming that the growth in the costs of CEOs' option holdings is indeed the fastest in the first years of employment. Opacity dummy, as with shares, is significant and is negatively correlated with the extent the options are used to remunerate CEOs (consistent with H3b). The effect of governance variables on the cost of option holdings, however, is not as pronounced as on holdings of shares. Concentrated managerial power, nomination committee size, board composition and percentage of large outside shareholdings all have the theoretically predicted signs, but statistical significance is, in general, inadequate.

Concentrated managerial power is only weakly statistically significant (at 6.5% level), however the potential magnitude of the effect may be quite essential. If accepted, it means that, in five years after CEO's employment, firms' opportunity losses due to CEO options are 45 % greater under concentrated managerial power than otherwise ($5^{0.231}$-1 = .45). In ten years this figure rises to 70 % ($10^{0.231}$-1 = .70).

So far, the descriptive regressions in columns 2 and 3 suggest that concentrated managerial power is associated with additional compensation costs to the company. We are interested, however, in the efficiency of these expenditures in terms of their effects on incentives WPE and RR (hypothesis H5). Two final regressions (columns 4 and 5) in Table 13 address this question by testing cost-efficiency of option effect on WPE: Log (ΔWPE / MAIE) and managerial conservatism RR.

Term ΔWPE denotes here the change in managerial wealth-performance elasticity due to option grants. As positive effect of WPE on firm performance is accepted with our prior tests, the ratio Log (ΔWPE / MAIE) would give options' incentive effect per unit of option cost. As the tests show, managerial wealth structure evolves and changes over time. CEOs tend to accumulate shareholdings over their tenure at the rate dependent on CEOs' power and moderated by the firms' corporate governance. Shares and options which CEOs already possess affect the way CEOs value newly granted options, discounting their value and their general incentive potentials. Therefore, cost-efficiency of managerial options might naturally decrease over managerial tenure as the shareholdings grow. Governance effects on this process help us to uncover what levels of option cost-efficiency are accepted under different corporate governance set-ups.

Regression 4 tests for the tenure effect on the cost efficiency of option grants and finds it negative and statistically significant. Managerial power concentration and board composition significantly influence the rate of efficiency deterioration. Under low concentration of managerial power, efficiency of option grants in boosting wealth-performance elasticity decreases by a quarter when CEOs' tenure doubles ($1 - 2^{-1.01 + 1.15 * 0.51} = 0.254$). However, CEO/Chairman duality combined with CEO control over board dynamics is associated with almost 39 % loss in the efficiency over the same time frame

$(1 - 2^{-1.01 + 1.15 * 0.51 - 0.284} = 0.388)$. High proportion of outsiders on the board is associated with lower rates in efficiency deterioration.

Regression 5 estimates the tenure effect on managerial conservatism in risk-taking appraisals (RR). As option- and share-holdings accumulate over time, managers are likely to become increasingly aware of the volatility of their pay and wealth with possible negative consequences for the firm value. H5 hypothesises that under concentrated managerial power there would be a higher risk of managers acquiring large holdings of shares and options with RR elevated dangerously high to the levels sufficient to destroy the link between WPE and firm performance.

The test shows that RR index indeed elevates with CEOs' time on their boards, reflecting accumulation of the equity-based holdings in managerial wealth. As in the case of the option cost growth, however, a saturation effect in the growth rate is detected by statistically significant quadratic term $(\text{Log of Tenure})^2$. Among the corporate governance variables, the regression finds statistically significant effects of concentrated managerial power and nomination committee size on the rate of growth in RR. Concentrated managerial power elevates the rate of growth in RR, whereas nomination committee size tends to slow it down.

The analysis of the results on the RR regression is summarised in the Table 14.

Table 14. Effect of power concentration and CEOs' tenure on managerial conservatism RR (sample average figures for nomination committee size and firm risk are assumed)

Tenure (years)	1	5	10	15	20	25
RR value, low managerial power	-0.102	0.302	0.383	0.404	0.407	0.402
RR value, concentrated managerial power	-0.102	0.369	0.478	0.515	0.530	0.534

Table 14 shows predicted values of managerial conservatism RR by CEOs' tenure and managerial power concentration. It illustrates our finding that managerial power increases

the rate of growth in RR and if CEOs stay at the power for more than 10 years, RR reaches the level of 0.5 – 0.53 where it tends to saturate. If CEOs do not enjoy the board and its nomination committee chairman powers, risk-return trade-off tends to saturate, on average, at a lower level of 0.4.

To put these values of RR into perspective, one should go back to the results of our performance regressions of firms' TSR on WPE and RR indices (column 2 in Table 12). The moderation effect of managerial conservatism RR on WPE – performance link, estimated by this regression, suggests that positive equity-based incentive effect of managerial shares and options statistically disappear when RR rises to the value of 0.53 (since (-0.025+0.52) / (-0.15+1.08) = 0.53). This coincides with average RR saturation level under concentrated managerial power, a condition which is present in our sample in 33 companies out of 204.

Joint analysis of regressions 3, 4 and 5 of *Table 13 allows us to speculate* that weak firm-specific corporate governance might be associated with steep, and maybe even unreasonably steep, growth in the company cost of executive remuneration (MAIE) and incentives WPE and RR. Indeed, these regressions present empirical evidence that option tranches to the powerful CEOs are costly (regression 3), of an inferior quality (regression 4), and powerful CEOs tend to acquire too much of risky equity in the long run (regression 5) which may be ultimately damaging for the firm value (Model 2, Table 12). This analysis provides empirical support in favour of the hypothesis H5, which concludes this empirical chapter.

Corporate governance variables which are found to have statistically significant and (partly) neutralizing effects on managerial power are board composition and nomination committee size. Effects of proportion of large outside shareholdings and remuneration committee size, although often of a theoretically predicted sign, are not robust enough in these tests.

7.2 Summary on empirical evidence

Let us start with Hypothesis 1, which is central to the thesis. It suggests the non-monotonic one-peak relationship between managerial involvement in their firms' equity and firm performance. Morck et. al. (1988) reported first empirical evidence on this issue, but their explanation involved a power-based, managerial "entrenchment hypothesis" external to the analysis of pure financial incentives. As suggested above, Morck-style regressions (as in column 1 of Table 13) are probably misspecified. This thesis offers alternative and somewhat supplementary explanation of empirical non-linearity on the basis on equity-based financial incentives only. Empirical non-linearity between WPE and firm performance is a result of the moderation effect of managerial conservatism on the WPE – performance link (column 2 of Table 12). Value creating financial incentives of equity-based pay and statistical effect of WPE on firm performance disappear if managers are too conservative in investment decisions. As managerial conservatism tends to rise with WPE, the efficiency of the equity-based incentives drops and the turning point occurs.

One of the consequences of this one-peak relationship is the costs of departures from the optimal attainable WPE and RR combination. As predicted by H3a and confirmed by the tests (column 2 of Table 12), these costs are more empirically evident in R&D intense environment. It is estimated that in R&D intense industries, joint effort- and risk-related effect of the average CEO's equity-holdings is associated with almost four percentage point's increase in TSR. This advantage in performance deteriorates if WPE becomes too low or RR too high, reflecting the costs of inferior incentives. In addition, R&D intense industries are found to use less heavy equity-based incentives, consistent with H3b (Table 13).

Empirical test of hypothesis H2 is, as already mentioned, beyond the scope of this thesis. It requires some further development in the "certainty equivalence" framework, e.g. new approaches to the estimation of the coefficient of managerial risk-aversion on an individual basis.

Results show that grants of at the money options double WPE, comparing to shareholdings of the same value (regression 3, Table 12). Given constant risk-adjusted option values, options with higher exercise price are associated with slower growth in the level of managerial conservatism (regression 4 in Table 12). This fact may specifically benefit risk-sensitive firms. Hypothesis H4 is, thus, supported.

The test of hypothesis H5 on the effect of corporate governance variables on the quality of designed option grants (measured by cost-efficiency of options and resulting levels in conservatism RR) is based on equity-accumulation models with CEO tenure. The results suggest that CEO/Chairman duality and CEO control over board dynamics (i.e. nomination committee is not established or chaired by the CEO) complement each other in their effects on the quality and size of equity remuneration.

Firstly, shareholdings of CEOs with Chairman powers and control over board composition are found to grow faster than the amount of the firm resources spent on managerial cash pay which is consistent with the power-based theory (Bebchuk et. al. 2002) that influential CEOs would find ways to grant themselves increasingly costly equity tranches (regression 2, Table 13). Secondly, we found some statistical evidence that CEOs' option grants under concentrated managerial power are found to be significantly costly: we estimate that, in five years after CEO's employment, firms' opportunity losses due to CEO options are 45 % greater under concentrated managerial power than otherwise. In ten years this figure rises to 70 % (regression 3, Table 13). Thirdly, the tests confirm that cost-efficiency of managerial options decrease over managerial tenure due to the growing shareholdings and this efficiency deterioration is significantly quicker under the heavy equity compensation habits of concentrated managerial power (regression 4, Table 13). And fourthly, we estimate that powerful CEOs tend to accumulate too much of risky equity in the long-run (if they stay in power for 10 – 15 years), thus elevating RR value to the levels not associated with ex-post efficiency of incentives (regression 5, Table 13). Corporate governance factors which are found partly balancing out the effects of managerial power on pay are board composition and nomination committee size.

These empirical results support hypothesis H5 and let us to conclude that concentrated managerial power (as measured by CEO/Chairman duality and CEO control over board

dynamics) influence the design and quality of managerial equity-based pay. The separation of CEO and Chairman roles and the adoption of independent nomination committee may lessen managerial influence over board dynamics and votes. This could provide a complimentary effect to the *efficiency* of other corporate governance mechanisms, in particular resulting in contract efficiency. This summary on the final results of hypothesis tests is illustrated in Table 15.

Table 15. Summary on Hypothesis Tests

Hypothesis	Tested?	Confirmed?	Comments
H1	Yes	+	Joint effort-related and risk-related effect creates pay-performance non-linearity
H2	No		Constant level of risk-aversion is assumed
H3a **H3b**	Yes	+	Both effort-related and risk-related effects are empirically stronger in R&D intense industries, consistent with the proposition that the negative effects of departures from optimal contracting increase with monitoring costs (H3a). R&D intensity is associated with less heavy use of equity-based incentives, consistent with H3b.
H4	Yes	+	Options create more powerful incentives for value creation (higher WPE) and lower distortion of managerial risk preferences (lower RR ratio) than grants of shares of the same value. High exercise price is associated with higher levels of WPE and lower levels of RR, which is argued to be particularly important for risk-sensitive firms
H5	Yes	+	Option tranches to the powerful CEOs are costly, of an inferior quality, and powerful CEOs tend to acquire too much of risky equity in the long run which is ultimately damaging for the firm value

CHAPTER 8. Summary and Discussion

8.1 Research Findings

This research has been driven by a need for better understanding of the incentive mechanism behind executive equity-based pay. While the economic benefits of appropriate financial incentives for hired workers are generally well recognised, top management agency situation is complicated with managerial discretion over firm risk.

In practice, the most common source of financial incentives for top management is managerial equity and equity-like holdings. Optimists might expect that equity-based incentives ensure the monotonic alignment of managerial actions with shareholder objectives of value creation. However, empirical evidence and careful risk-related analysis of the pure financial incentives created by equity-based pay lead to the hypothesis of a non-monotonic pay-performance relationship, due to managerial conservatism in investment appraisals. Oversized, equity-based "carrots" may make managers more preoccupied with preserving the firm's size rather than with running the firm effectively.

This research argues that equity-based managerial compensation indeed leads to a moderation of the agency problem if implemented cautiously. Reasonably sized equity-based incentives create a positive sense of involvement among managers, encouraging them to seek out and pursue more profitable investment opportunities for firms' resources. However, under higher levels of managerial involvement, the risk-related preferences of managers overfed with shares and options might stop and even reverse the alignment of managerial interests away from those of shareholders. Our statistical results are consistent with the view that empirical non-linearity between WPE and firm performance is a result of the moderation effect of managerial conservatism on the WPE – performance link. Value creating financial incentives of equity-based pay and statistical effect of WPE on firm performance disappear if managers are too conservative in investment decisions. In other words, if remuneration uncertainty becomes too high, the value-creating preferences of the managers transform into value-preserving, cautious behaviour, not aligned with objectives of well-diversified shareholders. Additional tranches of the firms' equity for

managers at this stage are not justifiable and give opportunistic managers another opportunity to extract rents.

The empirical tests are based on 1997/98 and some of the 1998/99 financial year data on companies in the FTSE350. Some researchers leave all financial sector aside when testing for CG mechanisms due to the tight regulatory standards in the sector. We excluded pension funds and insurance companies, specialising in portfolio investment, from our data. Performance of the funds which are using their capital mainly to invest in shares of other firms in the sample could not be considered as independent and would bias our statistical inference. Besides, these companies are "outliers" in a sense that they have few employees and usually have no executives on boards.

In this study, however, banks and other providers of finance remain in the sample as banks are arguably more diverse in their activities and thus represent less "endogenous" cases of finance sector. Large banks as Lloyds TSB may own an insurance company, their exclusion from the sample, however, has been tested and it does not affect our statistical results.

The quality of equity-based incentives is found to be vulnerable to self-serving behaviour by top executives holding too much power within their boards. These very powerful top managers (those combining CEO and Chairman roles and influencing board composition and dynamics) may influence the size and performance hurdles of their own incentive plans adopted. This research provides evidence that the *ex-post* quality of executive equity-based incentives (measured by their empirical relation with firm TSR) is higher in firms where CEO and Chairman roles are separated and CEOs do not chair boards' nomination committee.

The analysis suggests that shareholdings of CEOs with Chairman powers and control over board composition grow faster than the amount of the firm resources spent on managerial cash pay, which is consistent with the power-based theory of pay (Bebchuk et. al. 2002). Statistical evidence points out that CEOs' option grants under concentrated managerial power are increasingly costly: we estimate that, in five years after CEO's employment, firms' opportunity losses due to CEO options are 45 % greater under concentrated

managerial power than otherwise. In ten years this figure rises to 70 %. This fact becomes even more intriguing when tests confirm that cost-efficiency of managerial options decrease over managerial tenure due to the growing managerial shareholdings and this efficiency deterioration is significantly quicker under the heavy equity compensation of concentrated managerial power. And finally, we estimate that powerful CEOs tend to accumulate too much of risky equity in the long-run (if they stay in power for 10 – 15 years), thus elevating managerial risk-bearing to the levels not associated with ex-post efficiency of incentives.

Although corporate governance mechanisms substitute each other (as all of them target managerial opportunism) there are positive complementary effects of some CG mechanisms on the quality (or efficiency) of the actual compensation contracts. This thesis provides evidence to the following statements: CEOs' shareholdings in the boards with higher proportion of outsiders are lower, however, cost-efficiency of option grants increase with nomination committee size. Remuneration committee size and percentage of firms' outstanding shares owned by large outside shareholder do not produce statistically significant effects in our tests.

Overall, being generally optimistic, this research provides both theoretical grounds and empirical evidence for at least two problems concerning equity-based executive pay, which together may threaten its overall efficiency as a corporate governance tool.

- First, equity-based pay may be easily abused (and we found some evidence that it is actually abused) by powerful CEOs under weak corporate governance in spite of all existing regulations and "codes of best practice"
- Second, even if free of abuse, equity-based pay has some risk-related "side-effects", which may slow or even reverse the process of interest alignment.

This research argues that the resulting effect of managerial equity-based pay in one industry might be very different from the effect of the same incentive package in another industry. Thus, an optimal approach to the design of equity-based incentives is argued to be industry-specific. Focusing mainly on the pure financial side of the incentives, negative risk-related "side-effect" of managerial equity involvement is argued to be more acute in

risk-sensitive environment of high R&D intensity. Consistently with this argument, the tests found that R&D intense industries use less powered equity-based pay to motivate CEOs. In addition, both effort-related and risk-related effects are empirically stronger in R&D intense industries, consistent with the proposition that the negative effects of the departures from optimal contracting increase with monitoring costs.

Finally, executive option schemes are found to be a generally more effective solution of the agency problem than grants of plain shares themselves. Theoretical reasoning and empirical evidence suggest that close to at-the-money options may provide higher quality incentives than shares due to their pay convexity. Results show that grants of at the money options double WPE, comparing to shareholdings of the same value. Given constant risk-adjusted option values, options with higher exercise price are associated with slower growth in the level of managerial conservatism. This relative options efficiency may especially benefit risk-sensitive, opaque businesses.

8.2 Research Contribution

A lot of attention in this thesis has been devoted to potential risk-related agency costs, which are widely recognised both by researchers and practitioners (see Guay (1999)). This research contributes to this discussion theoretically and empirically. A basic principal-agent framework is extended in the thesis (Chapter 3) to encompass endogenous firm risk, reflecting the fact that top managers undoubtedly have both the power and desire to control firm risk to some extent. The developed revised model helps to separate effort-related and risk-related equity-based effects and thus tries to explain empirical, non-monotonic pay-performance relationship from the standpoint of pure financial managerial incentives. This explanation is supplementary to an existing power-based "entrenchment hypothesis".

This thesis formally introduces managerial discretion over firm risk in top management agency problem through an aggregation of the generalized managerial "effort" into an action vector (π, a), allowing the first element of the vector influence firm risk, and the second element be risk-independent. Managerial conservatism in investment appraisals, excessive diversification and "empire building", therefore, adversely affect risk-related

element π of managerial action. Perks consumption, excessive retention of earnings and managerial shirking resulting in waste in firm's resources (e.g. due to the failure to minimise operational costs) is captured by risk-independent element *a*. Risk-independent element *a* is still referred to as "effort" in a sense that it is costly for a manager to maintain high levels of *a* and low waste of firm's returns. This division of the aggregate "effort" into the action vector *(π, a)* allows for more accurate modelling of the effects of managerial actions, incentives and risk-aversion on shareholders' value.

Then, the "certainty-equivalence" approach of Hall and Murphy (2000) is extended to encompass the risk-related agency conflict and applied to the comparative analysis of options of various exercise prices and restricted shares (Chapter 4). Within this analysis, new incentive-related indices proposed by this research to measure the level of managerial conservatism (RR ratio) and the opportunity cost of option grants, or minimum assumed incentive effect (MAIE), are designed. The effects of option grants with various exercise prices on both effort-related and risk-related agency problems are considered (sections 4.2.2 and 4.2.3). The pros and cons of setting up high/low option exercise prices are explained both qualitatively and quantitatively using managerial wealth simulations. It is shown (section 4.4.2) that the firm's best choice of exercise price depends on the nature of the business, its environment and investment opportunity set. In particular, the analysis showed that firms that are more risk-sensitive (e.g. with higher R&D intensity) should benefit from higher exercise prices.

The extended certainty-equivalent approach provides us with a methodology to use firms' compensation committee reports to a full extent and carefully assess managerial diversification levels. Previous relevant empirical studies such as Agrawal and Mandelker (1987), DeFusco et al. (1990), Tufano (1996) and Guay (1999) had to settle on very simplifying assumptions relating to managerial risk conservatism in the context of options and shareholdings. Cross-sectional differences in managerial diversification levels, estimated by this research, are demonstrated as being too substantial to be ignored.

Finally, this research tests for the overall efficiency (measured by empirical relation with subsequent TSR) of executive option grants adopted in top UK companies and share-based incentives in the 1998/99 financial year (Chapter 7). In designing these tests, the thesis

makes an attempt to improve specifications of the classical and widely used Morck-style regressions. A risk-related element, based on our proxy for managerial conservatism RR, is incorporated in the statistical tests in an attempt to control for a reduction in the alignment effects due to managerial risk-aversion.

8.3 Weaknesses of this Study and Scope for Further Research

There are several obvious limitations to this research, which lie both in the adopted theory and statistical tests.

One of the simplifying assumptions we made while applying the developed "certainty-equivalence" methodology empirically was our assumption of a constant relative risk-aversion ρ. The coefficient of risk-aversion ρ is assumed to be independent of the level of managerial wealth and to be the same for all managers in the sample, which is, of course, vulnerable to a criticism. In reality, everyone's innate perceptions of risk are different. Assuming efficient labour markets, we can suppose that more risk-averse managers are on average attracted by less riskier firms on the market. This self-selecting hypothesis would imply that the cross-sectional differences in managerial conservatism are partly overestimated by this study. Although some overestimation probably takes place indeed, the major cause of cross-sectional variations in the estimated managerial conservatism is due to large variations in equity-based managerial wealth. This study argues that estimated equity-based managerial wealth covers a very wide range, so much so that the resulting variations in managerial conservatism could not be offset by natural diversity in the innate risk-aversion of managers. Therefore, I would argue here that relaxing the assumption of constant risk-aversion, assuming some self-selection on the part of the managers and assuming efficient labour market could not materially bias the results of the study.

The second obvious limitation of this study is that while it argues for substantial dynamics in the incentive-performance relationship, its empirical tests are based on cross-sectional studies only. Although we tried to control for the direction of causality by studying subsequent firm performance and allowing a one year lag for incentives to be realised, a proper time-series analysis would be, of course, preferable. The value and structure of partially equity-based managerial wealth clearly depends on past firm performance.

Therefore, present managerial incentives not only influence future firm performance, but also reflect to a certain extent its recent history. For example, executive share options in recently well performing firms are likely to be deeper in-the-money. If business trends remain the same, any cross-sectional study would conclude that deep-in-the-money options are associated with better subsequent firm performance. This relationship, however, would not be causal.

The study, therefore, argues for a robust time-series analysis based on at least four or five consecutive years of data on managerial incentive pay and firm performance. Statistical techniques as Granger causality tests, available for time-series data, would be more reliable tests on any long-term, sustainable, incentive-performance relationship than simple cross-sectional analysis.

APPENDIX 1. The Analysis of Labour and Risk Saturation Effects on optimal level of PPS

Proposition 1.

If

a) $t_m(a) = m * t(a)$,

b) π_m and a_m are corresponded managerial reaction functions, and

c) $\gamma_{opt,m}$ satisfies balance equation (3.15): $r(\pi_m(\gamma_{opt,m})) = t_m(a_m(\gamma_{opt,m}))$,

than the following holds: $\frac{d\gamma_{opt,m}}{dm} < 0$, i.e. a uniform increase in production saturation with labour yields to lower optimal PPS.

Proof: (3.15) may be re-written in the form $r(\pi_m(\gamma_{opt,m})) = m * t(a_m(\gamma_{opt,m}))$, following implicit differentiation yields

$$\frac{d\gamma_{opt,m}}{dm} = \frac{t}{t'\pi' - mt'a'} < 0,$$

since the nominator is positive and the denominator is negative.

Proposition 2.

If

a) $r_m(\pi) = m * r(\pi)$,

b) π_m and a_m are corresponded managerial reaction functions, and

c) $\gamma_{opt,m}$ satisfies balance equation (3.15): $r_m(\pi_m(\gamma_{opt,m})) = t(a_m(\gamma_{opt,m}))$,

than the following holds: $\frac{d\gamma_{opt,m}}{dm} > 0$, i.e. a uniform increase in production saturation with firm risk yields to higher optimal PPS.

Proof: (3.15) may be re-written in the form: $m * r(\pi_m(\gamma_{opt,m})) = t(a_m(\gamma_{opt,m}))$, following implicit differentiation yields

$$\frac{d\gamma_{opt,m}}{dm} = \frac{r}{t'a' - mr'\pi'} > 0,$$

since both the nominator and the denominator are positive

Appendix 2. Correlation matrix of corporate governance variables and structure of CEO's wealth

	Firm size	CEO / Chairman duality	INCD	Opacity Dummy	Log of CEOs' Tenure	Firm's Beta	Log of Basic Pay	Log of CEO's shareholdings	Log of CEO's option holdings
Firm size	1.0000								
CEO / Chairman duality Dummy	0.0144	1.0000							
INCD	0.2300***	-0.2961***	1.0000						
Opacity Dummy	0.1323*	-0.1476**	0.2167***	1.0000					
Log of CEO's Tenure	-0.1465**	0.2437***	-0.2277***	-0.0626	1.0000				
Firm's Beta	0.0800	0.0063	-0.0245	0.0396	0.0278	1.0000			
Log of Basic Pay	0.6133***	0.1233*	0.0472	0.0937	0.0162	0.1302*	1.0000		
Log of CEO's shareholdings	-0.0759	0.2288***	-0.2915***	-0.1722***	0.4771***	0.0734	0.1956***	1.0000	
Log of CEO's option holdings	0.2434***	0.0187	0.0413	-0.0973	-0.1500**	0.0699	0.4380***	0.0189	1.0000

*** $p < 1\%$
** $1 < p < 5\%$
* $5 < p < 10\%$

Correlation sub-matrix of independent variables is highlighted in grey. Our measures of corporate governance (CEO/Chairman duality, INCD and Log of CEO's Tenure) are found to be correlated, which is expected (see our discussion to Table 11). However, correlation coefficients are not particularly high (the highest being -.296 between CEO/Chairman duality dummy and independent nomination committee dummy INCD.

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